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Engineering Library

The Engineer.

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VOL. CXLIV.—No. 3745] LONDON: FRIDAY EVENING, OCTOBER 21, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. About 811 Tons STEEL B.S. 90 R.—F.F. RAILS and 1480 Pairs FISH-PLATES for B.S. 90 R.—F.F. RAILS.

2. 11 CRANK AXLES for LOCOMOTIVES.

Tenders due on the 1st November, 1927, for No. 1, and on the 11th November, 1927, for No. 2.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6830

Assistant Engineers (6) REQUIRED for the RAILWAY DEPARTMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, liberal leave on full salary. Candidates, aged 23 to 35, should either possess an engineering degree of a recognised University or should have passed sections "A" and "B" of the associate membership examination of the Institution of Civil Engineers. They should also have had 3 or 4 years' regular training as a civil engineer, preferably on railway works.—Apply at once by letter, stating age, particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15394. 6774

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 6769

The High Commissioner for India is prepared to receive APPLICATIONS for SIX APPOINTMENTS as CIVIL ENGINEERS, Burma Public Works Department, Buildings and Roads Branch. The appointments will be made temporarily on agreement for five years in the first instance, with the prospect, subject to satisfactory service, of transfer to permanent employment.

Candidates must be between 22 and 24 years of age and unmarried. They must have either (1) obtained a recognised university degree; or (2) passed Sections A and B of the A.M.I.C.E. examination; or (3) passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology) or obtained such other diploma or distinction in engineering as may be considered acceptable. In addition, at least one full year's practical experience of civil engineering under a qualified civil engineer is required.

The commencing pay will be Rs. 300 a month, rising by annual increments of Rs. 50 a month, plus overseas pay £20 a month. Overseas pay is admissible only to officers of non-Asiatic domicile.

Further particulars and forms of application may be obtained on request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 7th November, 1927. 6775

The High Commissioner for India is prepared to receive APPLICATIONS for the undermentioned APPOINTMENT in the service of the Government of the Punjab :—

ENGINEER for SANITARY DEPARTMENT, Buildings and Roads Branch.

Candidates should have had a sound general education, possess a recognised degree in engineering or equivalent qualifications, and have had at least two years' practical experience of sanitary engineering, design or construction. Age 26 to 30 years.

Information regarding the conditions of appointment and form of application may be obtained, upon request by postcard, from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 10th November, 1927. 6714

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

314 MILES OF SIX-CORE SIGNAL CABLE.

Specification and form of Tender can be obtained at the Company's Offices, 13², Gresham House, Old Broad-street, London, E.C. 2, on or after 17th October, 1927.

A fee of 10s. will be charged for each specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 28th October, 1927.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

17th October, 1927. 6784

The Engineer

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Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
Newcastle-upon-Tyne.
6627

County Borough of Barnsley
EDUCATION COMMITTEE.
MINING AND TECHNICAL COLLEGE.
PRINCIPAL: D. PATON GRUBB, A.R.S.M., M.Eng., &c.

APPOINTMENT OF FULL-TIME TEACHER IN MECHANICAL ENGINEERING.

The Higher Education Committee invite APPLICATIONS from fully qualified persons for the POSITION of FULL-TIME TEACHER in MECHANICAL ENGINEERING SUBJECTS. Salary in accordance with the Burnham Scale for Technical Teachers. Full particulars regarding the position may be had upon application to the Principal.

E. DAVIES,
Director of Education.
6705

PUBLIC NOTICES

Borough of Weymouth and Melcombe Regis.
TOWN BRIDGE RECONSTRUCTION, GENERAL CONTRACT.

TENDERS are INVITED for the GENERAL WORK to RECEIVE and SUPPORT a TWO-LEAF BASCULE BRIDGE, including Foundations in the harbour supporting Stone-faced Reinforced Concrete Walls, Parapets, Control House, &c., Temporary Footbridge, Roadway Widenings on Reinforced Concrete Piles and Platform. The steel bridge is being tendered for separately and is to be embodied in this general contract as a sub-contract.

Drawings are prepared and can be seen at the office of the Engineer for the work, Mr. H. W. FitzSimons, B.Sc., M. Inst. C.E., 39, Victoria-street, Westminster, S.W. 1. Copies of the specification, bill of quantities, and form of Tender are to be obtained from the Engineer's office on payment of Three Guineas, which sum will be returned upon receipt of a bona fide Tender and the return of all documents.

Tenders are to be sent to the undersigned not later than Noon on Monday, the 31st October, and endorsed "W.T.B.G.C."

The Corporation does not undertake to accept either the lowest or any Tender.

P. SMALLMAN,
Town Clerk.

Town Clerk's Office,
Weymouth. 6749

County Borough of Brighton.
PATCHAM PUMPING STATION EXTENSION. CONTRACT NO. 3.
TALL CHIMNEY AND ALTERATIONS TO BOILER-HOUSE.

The Corporation invite TENDERS for the ERECTION of a TALL CHIMNEY, 120ft. high, SEATINGS and FLUES for TWO NEW BOILERS, ECONOMISER SETTING, and ALTERATIONS and ADDITIONS to the existing BOILER-HOUSE at their Pumping Station, Patcham, near Brighton.

Drawings may be seen and copies of the general conditions, specification, bills of quantities and form of Tender may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, accompanied by a deposit of £5, which will be refunded upon receipt of a bona fide Tender not subsequently withdrawn and the return of all the documents.

Sealed Tenders, endorsed "Tender for Chimney, &c., Patcham Pumping Station," must be delivered to me on or before 14th November, 1927.

JAS. H. ROTHWELL,
Town Clerk.

Town Hall, Brighton,
18th October, 1927. 6796

PUBLIC NOTICES

Armourers and Brasiers' Company.
LECTURES IN METALLURGY.

The Company have arranged for the following Lectures to be delivered :

At the Royal School of Mines, Prince Consort-road, South Kensington, at 5.15 p.m., on the 8th, 15th, and 22nd November, 1927, by G. Shearer, Esq., M.A., D.Sc., on "X-RAYS AND METALS."

At the Chelsea Polytechnic, Manresa-road, S.W., at 8 p.m., on the 30th November, 7th and 14th December, 1927, by Professor Cecil H. Desch, D.Sc., Ph. D., F.R.S., F.I.C., on "THE DEFORMATION OF METALS."

Admission free, without ticket. 6816

Crystal Palace School of Practical Engineering,
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.

Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years. Students admitted at beginning of any term. 6642

County Borough of Newport, MONMOUTHSHIRE.
TEMPORARY BRIDGE OVER RIVER USK.

The Corporation invite TENDERS for the DEMOLITION and REMOVAL of the above STEEL and TIMBER BRIDGE.

All materials, with the exception of the tramways standards, rails and overhead equipment, gas and water mains, electric cables and road material (which are to be removed and placed at the disposal of the Corporation), are to become the property of the contractor. Full particulars and form of Tender can be obtained on application to the Engineers, Messrs. Mott Hay and Anderson, 9, Iddesleigh House, Caxton-street, Westminster, on payment of £2 2s. deposit, which will be returnable on receipt of a bona fide Tender.

The successful tenderer will be required with approved sureties to provide adequate security for the due performance of the contract and the complete indemnification of the Corporation in respect of all loss or damage. He will also be required to pay the trades union rate of wages and observe the recognised hours and rules of labour prevailing in the district.

Sealed Tenders, endorsed "Temporary Bridge," must be received by the undersigned not later than 10 a.m. on the 16th November next.

O. TREHARNE MORGAN,
Town Clerk.

Town Hall, Newport, Mon.,
19th October, 1927. 6817

Hartlepool Union.

The Guardians invite TENDERS for the SINKING of a 6in. diameter ARTESIAN BORED TUBE WELL, DEEP WELL PUMP SERVICES and PIT for Machinery, at Howbeck House, West Hartlepool. Copies of conditions, specifications, drawings, &c., prepared by Messrs A. Kinder and Son, Consulting Engineers, 33, Fitzroy-square, London, may be obtained on application to me. Applications must be accompanied by the sum of £2 2s., which will be refunded on return of the documents along with bona fide Tender.

Tenders are to be delivered to the undersigned on or before Noon on Wednesday, 9th November, 1927, in envelopes suitably endorsed, and the Guardians do not bind themselves to accept the lowest or any Tender.

(Signed) N. JEFFRIES,
Clerk to the Guardians.

Union Offices :
Hart-road, West Hartlepool,
Dated 17th October, 1927. 6783

Hartlepool Union.

The Guardians invite TENDERS for the ERECTION of a REINFORCED CONCRETE WATER TOWER and SUPPORTS, &c., at Howbeck House, West Hartlepool. Copies of conditions, specifications, drawings, &c., prepared by Messrs. A. Kinder and Son, Consulting Engineers, 33, Fitzroy-square, London, may be obtained on application to me. Applications must be accompanied by the sum of £2 2s., which will be refunded on return of the documents along with bona fide Tender.

Tenders are to be delivered to the undersigned on or before Noon on Wednesday, 9th November, 1927, in envelopes suitably endorsed, and the Guardians do not bind themselves to accept the lowest or any Tender.

(Signed) N. JEFFRIES,
Clerk to the Guardians.

Union Offices :
Hart-road, West Hartlepool,
Dated 17th October, 1927. 6782

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PUBLIC NOTICES

City of Hull Waterworks.

COTTINGHAM PUMPING STATION.
CONTRACT No. C 2.

The Water and Gas Committee are prepared to receive TENDERS from British Manufacturers for the CONSTRUCTION and ERECTION of THREE SETS of PUMPING PLANT (each set capable of delivering 4 million gallons of water per 24 hours), FOUR LANCASHIRE BOILERS, ECONOMISER and WATER SOFTENER at their Cottingham Pumping Station. Copies of the specification and forms of Tender, together with drawings of the existing buildings, can be obtained on or after Friday, the 21st instant, from the undersigned on payment of a deposit of £5, which will be refunded on receipt of a bona fide Tender. Cheques to be made payable to Mr. F. Steadman, City Treasurer.

Sealed Tenders, endorsed "Pumping Plant, Cottingham," must be delivered at the Town Clerk's Office, not later than 10 a.m. Monday, the 7th November, 1927.

W. D. BINGHAM,
Water Engineer.

Guildhall, Hull.
12th October, 1927.

Metropolitan Water Board.

COVERED SERVICE RESERVOIR AT BISHOPS WOOD, HORNSEY.

The Metropolitan Water Board invite TENDERS for the CONSTRUCTION of a COVERED SERVICE RESERVOIR in Mass and Reinforced Concrete, having a capacity of 20¼ million gallons, at Bishops Wood, in the Borough of Hornsey, in the County of Middlesex.

The drawings and contract documents may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 201).

Forms of Tender, conditions of contract, specification and bills of quantities, together with drawings and a spare copy of the bills of quantities may be obtained on and after Monday, 24th October, 1927, from the Chief Engineer, on production of an official receipt for the sum of £10, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Bishops Wood Reservoir," must be delivered at the office of the Board (Room 122) not later than 10 a.m. on Monday, 21st November, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board.
173, Rosebery-avenue, E.C. 1
6th October, 1927. 6712

Metropolitan Water Board.

MAIN—FORTIS GREEN TO SOUTHGATE.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of approximately 5960 LINEAL YARDS of 24in. Diameter CAST IRON MAIN, together with CONNECTIONS and CONTINGENT WORKS, from Woodside-avenue, Fortis Green, in the Borough of Hornsey, to Durnsford-road, in the Urban District of Wood Green, and from Chase-road to the Board's Reservoir at Southgate, in the Urban District of Southgate, within the County of Middlesex.

The drawings and contract documents may be inspected without charge at the Offices of the Board, Chief Engineer's Department (Room 201).

Forms of Tender, conditions of contract, specifications and bills of quantities, together with drawings and a spare copy of the bills of quantities, may be obtained on and after Monday, 24th October, 1927, from the Chief Engineer, on production of an official receipt for the sum of £10, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Main, Fortis Green to Southgate," must be delivered at the offices of the Board (Room 122) not later than 10 a.m. on Monday, 21st November, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board.
173, Rosebery-avenue, E.C. 1,
6th October, 1927. 6713

Metropolitan Water Board.

MAINS FOR THE SUPPLY TO CHESHUNT.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of the following CAST IRON MAINS, together with CONNECTIONS and CONTINGENT WORKS :—

6220 Lineal Yards of 20in. Diameter Main in Cambridge-road, from Hoe-lane to Brookfield-lane.

400 Lineal Yards of 14in. Diameter Main in Brookfield-lane, from Cambridge-road to the Board's Pumping Station.

600 Lineal Yards of 12in. Diameter Main in Brookfield-lane, from the Board's Pumping Station to Longfield-lane,

in the Urban Districts of Enfield and Cheshunt.

The drawings and contract documents may be inspected without charge at the Offices of the Board, Chief Engineer's Department (Room 201).

Forms of Tender, conditions of contract, specification and bills of quantities, together with drawings and a spare copy of the bills of quantities may be obtained on and after Monday, 24th October, 1927, from the Chief Engineer, on production of an official receipt for the sum of £10, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Mains for the Supply to Cheshunt," must be delivered at the offices of the Board (Room 122) not later than 10 a.m. on Monday, 21st November, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board :
173, Rosebery-avenue, E.C. 1,
6th October, 1927. 6792

Margate Life-Boat Station.

The Committee of Management of the Royal National Life-Boat Institution are prepared to receive TENDERS for the REMOVAL of the whole of the Institution's SLIPWAY and BOAT PLATFORM on the west side of the Margate Pier and Harbour Company's Jetty.

The structure consists of five supports of braced steel piles, driven into the sea bed, a steel work decking partly covered by timber platforms and partly open work with a cast iron stepped gangway on one side. The materials removed will become the property of the contractor.

A form of Tender, terms and conditions of contract and specification can be obtained from Messrs. Lewis and Lewis, Consulting Engineers, 15, Victoria-street, Westminster, London, S.W. 1.

Tenders, which will only be accepted on the forms supplied, are to be submitted on or before the third day of November, 1927.

The Committee of Management do not bind themselves to accept the lowest or any Tender.

GEORGE F. SHEE,
Secretary.

Life-Boat House,
22, Charing Cross-road, London, W.C. 2. 6821

PUBLIC NOTICES

Greenwich Union.

The Guardians invite TENDERS for the INSTALLATION of a WATER SOFTENING PLANT, Zeolite Type, at their new Nurses' Home, Vanbrugh-hill, Greenwich.

Capacity 500 gallons per hour. Regeneration after each 5000 gallons.

Further particulars may be obtained and the premises inspected on application to the Steward of the Greenwich and Deptford Hospital, 48, Vanbrugh-hill, S.E. 10, during ordinary office hours.

Tenders should be sent to the undersigned by 2nd November, 1927.

By Order,
W. C. CORNISH,
Clerk to the Guardians.

October, 1927. 6791

Scarborough Corporation.

NEW IRTON WATER SCHEME.
CONTRACT No. 4.
PUMPING STATION BUILDINGS.

The Corporation invite TENDERS for the CONSTRUCTION of a high-class PUMPING STATION BUILDING on the property of the Corporation Waterworks at Irton, near Scarborough.

The Contract will include Foundations of Reinforced Concrete Piles and Beams and a Superstructure of Brickwork with Artificial Stone Dressings; Reinforced Concrete Roof, &c. Foundations for machinery, embanking, road-making and short lengths of pipe-laying are also included in this contract.

Copies of the conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the UNDERSIGNED on or after Monday, October 17th. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.

Facilities for examining the drawings, for inspecting the site and general information can be obtained on application to Mr. Herbert Richardson, M. Inst. W.E., the Water and Streets Engineer to the Corporation, Town Hall, Scarborough, and from Mr. M. B. Mawson, M. Inst. C.E., the Resident Engineer for the New Irton Scheme, Spring Hill, Scarborough.

Tenders are to be sent in on the form supplied, and with the annexed documents must be enclosed in a sealed cover, endorsed "New Irton Water Scheme: Tender for Contract No. 4," addressed to and reaching the UNDERSIGNED not later than 10 a.m. on Monday, November 7th.

It is particularly requested that none but Engineering Contractors experienced in heavy foundation and reinforced concrete work should apply.

The Corporation do not bind themselves to accept the lowest or any Tender.

SYDNEY JONES,
Town Clerk.

Town Hall, Scarborough,
11th October, 1927. 6748

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for :—

CREOSOTING PLANT.
ADZING AND BORING PLANT.

Specifications and Tender forms may be obtained at the Offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2.

A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had, at the cost of the tenderer, by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Friday, 4th November, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Secretary.

13th October, 1927. 6813

The South Indian Railway

COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

4-WHEEL BOGIES FOR METRE-GAUGE WAGONS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Bogies," must be left with the undersigned not later than Twelve Noon on Friday, the 4th November, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, London, S.W. 1,
18th October, 1927. 6819

Abertillery and District Water Board.

SALE OF PLANT.

The above Board offer FOR SALE extensive ELECTRICAL, STEAM, and other PLANT, recently used in the construction of a large concrete masonry dam.

The following are some of the principal items :—

Generating Plant, consisting of No. 2 Ruston and Hornsby 250 H.P. Gas Engines and Producer Plants with No. 2 Metropolitan-Vickers 150 kW, 500-v. Dynamos.

No. 1 100 H.P. National Gas Engine and Producer Plant with No. 1 Bruce-Peebles 100 kW, 500-v. Dynamo.

No. 4 Anderson-Grice 2-ton 3-motor Electric Loco. Cranes.

No. 4 Steam Derrick Cranes, 4 and 5-ton.

No. 2, 14in. by 12in. Ingersoll-Rand Air Compressors with 500-volt Motors.

No. 1 W. D. Wild Haulage Engine and Motor.

No. 1 Double Concrete Hoist, 180ft. high, by Stothert and Pitt, with trussed steel chutes, hoisting winches, 1-yard mixers, and 500-volt motors.

No. 1 Crushing and Sand Plant, by Hadfields, comprising No. 2 Jaw Breakers, 20in. by 10in.; 2 Hecla Disc Crushers; 1 Jaw Breaker, 16in. by 9½in.; 1 Pan Mill, Screens, Elevators and Shafting, driven by No. 3 75 H.P., 500-volt Motors.

No. 1 Leyner Drill Sharpener, by Ingersoll-Rand Co.

No. 1 Oil Furnace and Tank.

No. 7 Steam Locomotives, 3ft. gauge.

No. 1 5-ton Cableway, by Henderson, 1100ft. span, luffing head masts, electrically driven.

No. 4 Steam Loco. Cranes, 3 and 5 ton.

Together with many other items.

Further particulars can be obtained from the Board's Engineer, Mr. J. FRANCIS JUPP, M. Inst. C.E., Midland Bank Chambers, Newport, Mon. 6701

Parish of Stepney.

RESIDENT CHIEF ENGINEER.

The Guardians of the Parish of Stepney invite APPLICATIONS for the APPOINTMENT of RESIDENT CHIEF ENGINEER to control and supervise the whole of the Engineering Departments of their London Establishments and also to be directly responsible for the Engineering Department at the Mile End Hospital premises.

The remuneration will be at the rate of £400 per annum, rising by annual increments of £10 to £450, together with the emoluments (valued for superannuation purposes at £62 10s. per annum) of an unfurnished house, lighting, coal and gas.

Forms of application, giving other conditions of service, may be obtained from the Administrative Offices, Bancroft-road, London, E. 1, or will be sent, upon receipt of a stamped, addressed foolscap envelope, and must be returned to that address by not later than first post on Saturday, 5th November, 1927.

By Order,
S. MCCLELLAND,
Clerk to the Guardians.

Administrative Offices,
Bancroft-road, E. 1,
17th October, 1927. 6785

PUBLIC NOTICES

The North British Aluminium

COMPANY, LIMITED.
LOCHABER WATER POWER.
SPECIFICATIONS NOS. 102 AND 103.

THE NORTH BRITISH ALUMINIUM CO., Ltd., is prepared to receive TENDERS for the CONSTRUCTION, DELIVERY and ERECTION, at their Powerhouse near Fort William, Inverness-shire, of :—

(1) WATER TURBINES (Impulse Type) (Specification No. 102).

(2) ALTERNATORS and EXCITERS (Specification No. 103).

Persons desiring to Tender may obtain, on and after the 25th October, 1927, from the Company's Offices, Adelaide House, King William-street, London, E.C. 4, copies of the drawings, specifications, form of Tender, &c., upon production of evidence, to the satisfaction of the Company, of their ability to carry out such work.

Preference will be given to contractors on the King's Roll.

Sealed Tenders, endorsed :—

LOCHABER WATER POWER,
Specification No. .....
Tender for .....

must be addressed to the SECRETARY and delivered at the Company's offices not later than 10 a.m. on Tuesday, the 22nd November, 1927.

The Company does not bind itself to accept the lowest or any Tender. 6798

City of Stoke-on-Trent.

ELECTRICAL ENGINEER'S DEPARTMENT.

APPLICATIONS are INVITED for the POSITION of ENGINEERING ASSISTANT in the Office of the City Electrical Engineer on Grade 4, Class F, of the National Joint Board Schedule.

List of duties and forms of application obtainable from the City Electrical Engineer, St. George's Chambers, Kingsway, Stoke-on-Trent.

E. B. SHARPLEY,
Town Clerk.

17th October, 1927. 6799

Indian State Railways.

PRODUCTION ENGINEER FOR TATANAGAR WORKSHOPS (EAST INDIAN RAILWAY).

A PRODUCTION ENGINEER is REQUIRED for service in the Mechanical Department of the above Railway for the Planning, Production and Progress Section for the mass production of Underframes for Carriages and Wagons.

Age between 25 and 35 years.

QUALIFICATIONS.—Candidates must have held a responsible administrative position, such as Production Engineer or Head Planner and Rate Fixer in a large Carriage and Wagon Works, and be capable of organising a large works system and layout. They must be familiar with coaching stock, underframe design, and be able to initiate and control planning, rate fixing, progress, inspection and costing departments. A good knowledge of modern gauging methods and also of works stores procedure is essential.

SALARY.—Initial salary Rupees 425 plus Rs. 150 overseas pay to Rs. 675 plus £25 overseas pay, according to age and qualifications. Salary payable from date of landing in India, subject to rules in force. Provident Fund and gratuity in accordance with the rules applicable to officers of Indian State Railways.

Agreement for 3 years in first instance, but service to be extensible beyond that period with the consent of both parties concerned.

Leave in accordance with the rules applicable to officers of the Indian State Railways.

A free first-class passage to India will be provided on appointment.

Particulars of candidate's career, giving in chronological order (with dates) details of general and technical education, where apprenticeship or pupilage was served, and subsequent experience, and stating age and whether they are married or single, accompanied by COPIES ONLY of testimonials, should be addressed to the undersigned not later than the 28th October, 1927, but application will be considered as received.

RENDEL, PALMER & TRITTON,
12/14, Dartmouth-street,
6776 London, S.W. 1.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ENGINEER for Foreign Sales Department. Well educated, good practical and technical training, also selling experience. Languages essential, and commercial experience abroad desirable. —Write, giving full particulars of age, experience, and salary required, to EMPLOYMENT DEPARTMENT, Hans Renold, Ltd., Burnage Works, Didsbury, Manchester. 6786 A

WANTED, ENGINEER with Experience in the Design and Manufacture of Artificial Silk-making Machinery, to act as ASSISTANT to Manager. Trade connections essential, as successful applicant would require to call on buyers and obtain orders. —State age, experience and salary required, and address application to P3765, The Engineer Office. P3765 A

WANTED for Glasgow District, SALES ENGINEER, conversant with Modern Engineering Practice, Salesmanship essential. State age, experience, and salary required.—Address, 6803, The Engineer Office. 6803 A

WANTED, Fully Experienced PRACTICAL ENGINEER, who has held some responsible position. The man must be accustomed to the Maintenance of General Works Plant, including Engines, Electrical Installation, Machines and Motor Vehicles. Statistics will be required to be kept in detail of working costs, &c. None other but really competent men need apply. The salary to be paid is approximately £300 per annum.—Address, stating experience, age, &c., 6811, The Engineer Office. 6811 A

WANTED, WORKS MANAGER, Age Under 40, accustomed to the control of men, who can work to cost, with drawing office experience, knowledge of Internal Combustion Engines. Salary £500 per annum.—Address, stating experience, &c., P3794, The Engineer Office. P3794 A

A FIRM of CONTRACTING ENGINEERS in the London District REQUIRE the SERVICES of a SKILLED ENGINEER to act as SALES MANAGER. Wide experience in General Engineering and sales organisation essential, and evidence of a success in a similar capacity must be produced.—Address, stating age, experience, qualifications, and salary, to P3798, The Engineer Office. P3798 A

ACTIVE DIRECTORSHIP OFFERED in Midlands district to man of good type with Works Connections. Experiences Gauging and Production Methods essential.—Write, Box 417, Sells, Fleet-street, E.C. 4. 6737 A

AN ENGINEERING JOURNALIST, with Editorial experience. Applicants should give full details of age, education, professional and journalistic experience. Also give exact details of recent staff experience on sound engineering journal, clearly defining exact range of duties. State whether attached at present and salary expected and earliest date at liberty. Only letters containing the full information asked for will be considered.—Address, 6824, The Engineer Office. 6824 A

CIVIL ENGINEER REQUIRED for Sudan. Salary £500 p.a. Age 23 to 27, single, robust, with practical experience in Levelling, Surveying and Construction of Buildings.—Write, stating full particulars, to "D. E.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 6805 A

CIVIL ENGINEER WANTED, for Southern Europe. Only M.I.C.E. or A.M.I.C.E., with railway and general civil engineering experience, need apply. Knowledge Spanish desirable.—Write, stating age, experience, and salary required, to "C.E.," c/o Street's, 6, Gracechurch-street, E.C. 3. 6823 A

SITUATIONS OPEN (continued)

DAVID BROWN and SONS (HUDDERSFIELD), Ltd., Lockwood, Huddersfield, REQUIRE the SERVICES of a fully qualified MAN to Act as BUYER and STORES CONTROLLER. Applications are invited from first-class men only and should state age, previous experience, and salary required., 6787 A

MANAGER'S ASSISTANT WANTED. State Age, training, works and office experience, salary required.—GRAFTON and CO., Vulcan Works, Bedford. 6801 A

MANY SKILLED ENGINEERS, Owing to Depression in the industry, fail to see any immediate prospects of advancement. A good Engineering Training is the basis for good salesmen for lubricants. Any Engineers wishing to become Salesmen are invited to write to Box 109, c.o. Walter Hill, 67/9, Southampton-row, London, W.C. 1, giving all particulars and qualifications, age, &c., THESE WILL BE CONSIDERED FOR APPOINTMENTS WHICH WE HAVE IN VIEW. 6752 A

OLD-ESTABLISHED FIRM of MECHANICAL ENGINEERS in India REQUIRE a trained ENGINEER SALESMAN. Good prospects. Age not over 24, unmarried; good education and address and experienced in Oil Engines and General Machinery.—Reply, giving fullest details education, engineering experience, present work and salary, to "Z.H. 411," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 6820 A

REQUIRED for British-owned Railway in Argentina :—

ASSISTANT CIVIL ENGINEER for NEW WORKS for investigation of all new works and preparation of new schemes and for administrative duties in execution of same; to have good railway experience, if possible in South America; well up in design and construction of all details.

ASSISTANT CIVIL ENGINEER for BRIDGE-WORK; must be thoroughly conversant with railway bridge calculations, design, erection, maintenance and strenthening.

Age 26/35. Salary £650/700.—Write, giving details of education, training, experience, age, &c., with testimonials (copies only), to Box B. L. A., 95, Bishopsgate, London, E.C. 2. 6808 A

SUPERINTENDENT ENGINEER WANTED by a large Concern to Reorganise Production in their various works on progressive economical lines; only an engineer of experience capable of producing evidence of success in a similar capacity will be considered.—Address, giving fullest details of past record in strict confidence, 6698, The Engineer Office. 6698 A

THE CHURCHILL MACHINE TOOL CO., Ltd., Broadheath, Manchester, REQUIRE the SERVICES of a MACHINE TOOL REPRESENTATIVE with thorough knowledge of Precision Grinding Machines. Selling experience essential.—Reply, giving references, experience, and salary required, to the above address. 6780 A

WANTED, DRAUGHTSMAN, Near London, with wide modern experience in design of Coal and Coke-handling Plants. First-class man required. Also experienced TRACER (Male).—Address, 6825, The Engineer Office. 6825 A

WANTED, ESTIMATING DRAUGHTSMAN for Steel Lap-welded Pipe Manufacturer's Office. Accustomed to estimating sizes 13in. to 72in. bore pipes. State age, wage, and experience.—Address, 6809, The Engineer Office. 6809 A

WANTED, 2 Competent DRAUGHTSMEN, Experienced in Grain-handling Machinery and General Conveying Work.—Address, stating experience, age, and salary required, 6827, The Engineer Office. 6827 A

DRAUGHTSMAN REQUIRED for London. Thoroughly experienced in designing Steam Accessories for Lancashire Boilers, such as Superheaters, Steam Driers and Traps, Feed Water Regulators, &c. One with shop experience preferred. State age, salary, training and experience.—Address, 6789, The Engineer Office. 6789 A

DRAUGHTSMEN WANTED AT ONCE, Senior and Junior; Aircraft and Workshop Experience essential.—Apply, stating age, experience, and salary required, to WESTLAND AIRCRAFT WORKS, Yeovil, Somerset. 6796 A

DRAUGHTSMAN for Steel-framed Rolling Stock REQUIRED, South Wales. Usual particulars. —Address, 6779, The Engineer Office. 6779 A

DRAUGHTSMAN REQUIRED, with Experience in the design of all classes of Jigs, Tools and Fixtures for accurate production. London district.—Address, stating age, experience, and salary required, 6797, The Engineer Office. 6797 A

DRAUGHTSMAN WANTED for the Argentine. First-class draughtsman, thoroughly experienced in the design and detailing for workshops of all classes of Structural Steel Work, particularly Frames for Buildings.—Address, giving full particulars of education, age, training, and experience, 6778, The Engineer Office. 6778 A

ENGINEERING DRAUGHTSMAN, with Sound mechanical knowledge. Some structural experience essential. State age, experience and salary required. Croydon district.—Address, P3796, The Engineer Office. P3796 A

EXPERIENCED RAILWAY CARRIAGE and WAGON DRAUGHTSMEN REQUIRED. State experience and salary required.—Apply by letter to BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Smethwick. 6810 A

FIRST-CLASS MECHANICAL DRAUGHTSMAN WANTED; must have had all-round experience in shops and offices of firm of good standing. Age about 30. Good salary and prospects for suitable man.—Address, stating age and experience, with salary required, P3787, The Engineer Office. P3787 A

MECHANICAL DRAUGHTSMAN, with Good Practical and theoretical training, REQUIRED for works in London area.—Address, stating age, salary required, and experience, 6828, The Engineer Office. 6828 A

PROMINENT MOTOR CAR MANUFACTURERS REQUIRE skilled JIG and TOOL DRAUGHTSMAN.—Write, stating age, experience, and salary required, to Box 533, Sells, Fleet-street, E.C. 4. 6815 A

REQUIRED IMMEDIATELY, a FIRST-CLASS DRAUGHTSMAN for London Office. Must be a good designer and have a wide experience in conveyor, crane, and transporter practice.—Address, stating age, experience and salary required, to P3797, The Engineer Office. P3797 A

YOUNG DRAUGHTSMAN WANTED, with workshop experience, age 25 to 30, for Calcutta office of Waterworks Engineers and Contractors. Salary 500 Rupees per month, with yearly increments of 50 R. per month. Five years' engagement. Situation offers good ultimate prospects for suitable man.—Address, giving particulars of age, engineering and drawing-office experience, etc., 6826, The Engineer Office. 6826 A

THE COMPAGNIE DES GRANDS LACS AFRICAINS, of 24, Avenue de l'Astronomie, Bruxelles, invites APPLICATIONS from experienced persons for the POST of OVERSEER of SHIPYARD in Africa; knowledge of Assembling, Riveting, Launching, &c., essential, also rudiments of French or Flemish. Three years' contract; salary according to ability. 6814 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Mr. Blight of "Griffins."

MR. FRANCIS JAMES BLIGHT, who for thirty-three years past has been associated with the fortunes of the publishing house of Charles Griffin and Co., Ltd., is retiring from the position of chairman and managing director, which he has held for the last twenty-eight years. We feel sure he will carry with him in his retirement the kindly recollections and good wishes of many of our readers. The progress of modern scientific literature, and, in particular, of the literature of scientific technology has, within the last quarter of a century or so, been so rapid and so widespread that it is apt to be forgotten that a generation ago it was a comparatively new development. Great teachers existed at that time, but the "text book" of the day, upon which the student and the earnest workman, alike in the laboratory and in the workshop, so greatly depend, left a great deal to be desired. Mr. Blight had the discernment to perceive and the forethought to supply what was lacking, and under his administration his firm took a foremost place in the publication of literature of the kind so greatly needed.

Goods Traffic on British Railways.

SPEAKING on Tuesday before a gathering of railway employees at York, Mr. W. R. Bell, assistant manager of the London and North-Eastern Railway, criticised the general slowness with which the railway companies handle ordinary goods and mineral traffic. He stated that on British railways the average movement of wagons was only 10¼ miles per day, and that their wheels were turning for only 1½ hours out of the twenty-four. The average wagon capacity was 10¾ tons, but the average load was only 5½ tons. The average speed of goods trains was 8½ miles an hour. If, he said, the average wagon load could be increased by 1 ton, the result would be equivalent to the addition of 250,000 wagons to the country's stock of wagons, and would represent a sum of about £40,000,000. In America one railway had succeeded in raising the average car mileage from 24 per day in 1920 to 43 in 1926, while others had this year increased the number of cars per train and at the same time had raised the average speed to 12½ miles an hour. Much money had been spent in remodelling the freight yards. At the "hump" yards car retarders were being generally adopted. These retarders consisted of electrically operated shoes controlled from towers to regulate the speed of cars running down from the "hump." Their use was claimed to reduce the cost of handling cars over the "hump" by 40 per cent. In Germany the large yard at Hamm had been equipped with the Fröhlich brake at a cost of £15,000. That sum, it was said, had already been recovered in the economies effected. So far as the running of fast braked or partially braked goods trains carrying perishables and high-class merchandise, this country held, Mr. Bell said, a leading position, but as regarded general goods and mineral traffic there was, he held, a clear call to all concerned to assist in the attainment of greater speeds and larger wagon and train loads.

The Late Mr. H. M. Taylor.

THE death on Sunday at the age of eighty-five of Mr. Henry Martyn Taylor, senior Fellow of Trinity College, Cambridge, closes a mathematical and scientific career of very great human interest. Mr. Taylor in 1865 graduated as Third Wrangler and Second Smith's Prizeman, the Senior Wrangler and First Smith's Prizeman being the late Lord Rayleigh. In the same year he was appointed Vice-principal of the newly established Royal School of Naval Architecture and Marine Engineering—since transferred to the Royal Naval College at Greenwich. Among his pupils was the late Sir William White, who rose to be Chief Naval Constructor. In 1869 he was called to the Bar by Lincoln's Inn, but he elected to return to Cambridge. Until 1874 he served as assistant tutor at Trinity College and for the succeeding ten years as tutor. Down to 1894 he remained one of the mathematical lecturers. In that year he completed the twenty-five years' service allowed by the statutes, and might have been well content to retire from active life, particularly as his eyesight was giving him trouble. The trouble developed. First one eye failed him and then the other, and he was stricken with complete blindness. He lost neither his courage nor his serenity. His affliction opened a new life to him. With the help of amanuenses whom he trained in mathematical work, he wrote several mathematical papers after blindness had fallen upon him, and in 1898, when blind, he was elected a Fellow of the Royal Society for his mathematical attainments. His chief occupation was, however, first the acquisition of a knowledge of the Braille system, and then the development of that system to cover mathematical symbols, diagrams and figures. With the aid of some friends who collected a fund in admiration of his courage, he set to work to translate into Braille books on geometry, algebra, conic sections, trigonometry, astronomy, geology, metaphysics, physiology, sound, music, and mechanics. Every symbol on every page of every book was cheerfully and patiently stippled by his own hand. His work for his fellow-sufferers, it is good to know, will be continued by the Embossed Scientific Books Fund, administered by the Royal Society. Apart from his scientific work, Mr. Taylor, in spite of his blindness, continued, and even increased his interest in the town of Cambridge. He became a member of the Town Council, was Mayor in 1900–1901 and for several years was Chairman of the Finance Committee and a borough magistrate.

The Mechanisation of the Army.

UNDER the reorganisation scheme adopted in consequence of progress in the mechanisation of the Army the Directorate of Equipment and Stores has now been re-named the Directorate of Ordnance Stores and has been transferred from the control of the Quartermaster-General to that of the Master-General of the Ordnance. The transference of the control of fortification works from the Master-General to the Quartermaster-General has also taken place and has established the new Directorate of Works. The Mechanical Transport Experimental and Designs Branch of the R.A.S.C. and that part of the Mechanical Transport Inspection Branch which deals with vehicles other than those on the establishment of the R.A.S.C. have been transferred to the new Directorate of Mechanisation, which has been placed under the charge of Colonel S. C. Peck, formerly Director of Artillery. Colonel Peck is a graduate of the Artillery College, now the Military College of Science. From the artillery he returned to Woolwich as Proof and Experimental Officer in the Arsenal's Research Department. Later he became Assistant Inspector of Ordnance and Assistant Director of Artillery, and in 1924 was appointed to the experimental side of the Directorate of Artillery at the War Office.

A Large Low-Temperature Carbonisation Plant.

ALTHOUGH several of our home gas companies have interested themselves in low-temperature carbonisation processes, and trial plants have been installed, development is proceeding much faster in America, where several large commercial plants are under consideration. Within the last few days an agreement has been reached between the Public Service Electric and Gas Company of New Jersey, and the International Combustion Engineering Corporation of New York, whereby the latter undertaking will erect at Raritan, New Jersey, U.S.A., an eight-retort low-temperature carbonisation plant embodying the K.S.G. process, which will have a capacity of 650 tons of raw coal per day, and will be, we are informed, the largest plant of its kind in the world. The gas company has undertaken to purchase up to 4,000,000 cubic feet of 530 B.Th.U. gas per day, and the present plant will supply over 3,000,000 feet. Provision has been made for later extensions which will probably increase the capacity of the plant to 2600 tons of raw coal per day. The new plant will comprise eight K.S.G. rotary retorts, which will be designed to convert relatively cheap bituminous slack into a semi-coke suitable for domestic use, which product will be more valuable commercially than the untreated slack. It is estimated that 16,000 gallons of low-temperature tar will be produced per day, as well as a gas having a heating value of about 800 B.Th.U. per cubic foot. As the gas company requires a 530 B.Th.U. gas, the plant will include a water-gas installation, so that the desired heating value can be obtained by blending. The K.S.G. process takes its name from the Kohlenscheidungs-Gesellschaft, the company under which it was developed by the late Hugo Stinnes, and placed in commercial operation in the Ruhr district.

The National Electricity Scheme.

KEEN competition is anticipated in connection with the tenders for the Scottish electricity scheme, which are to be lodged with the Central Electricity Board by noon on Monday of next week. Foreign firms are likely to submit offers, and this fact has revived criticism of the Government's policy of refraining from enacting that the work must be given to British firms only. According to Mr. D. N. Dunlop, the director of the British Electrical and Allied Manufacturers' Association, "the national power scheme was initiated primarily to assist British industry, not merely through the realisation of cheap power, but through extensive orders for equipment and plant for the supply and distribution of power." Is the national credit, he asks, to be used to finance the importation of foreign plant, or is it the intention to use the foreign tenders as a means of forcing British firms to quote uneconomic prices? This question of admitting or excluding foreign tenders was, it may be recalled, fully debated during the Committee stage of the Bill. The Government opposed an amendment designed to forbid the purchase of foreign plant and machinery on the familiar ground that the Central Electricity Board should not have its discretion fettered and that it was undesirable to do anything that would encourage the creation of a "ring" and the imposition of an artificial price. When it was objected that the national electricity schemes would be carried out under a Treasury guarantee and therefore indirectly with the assistance of public money, it was pointed out that two-thirds of the electrical orders of this country at present came from public authorities using public money. These bodies were trusted to give a preference to British manufacturers as far as possible, and there was no reason to believe that the Central Board could not equally be trusted to do its best to encourage British industry. It may be added that a certain amount of interest and curiosity has been aroused among engineers by the announcement that Sir Reginald Blomfield, R.A., has been appointed by the Board to advise it on questions arising in connection with the design and colouring of the towers to be used for the transmission lines.

H.M.S. Nelson as Flagship.

THE new battleship Nelson is to be commissioned to-day—Friday—as flagship of Vice-Admiral the Hon. Sir Hubert Brand, Commander-in-Chief, Atlantic Fleet, whose flag hitherto has flown in the Revenge. It is most appropriate that the ship bearing the name of our greatest naval hero should begin her maiden commission on the anniversary of Trafalgar. The Nelson is commanded by Captain the Hon. M. R. Best, D.S.O., who is also chief of staff to the Vice-Admiral. This vessel, with her consort, the Rodney, represents the most powerful type of battleship ever built. The displacement in light condition is 35,000 tons, the designed speed is 23 knots, and the main armament comprises nine 16in. guns mounted in triple turrets, all of which are situated in the forward part of the ship. Although the results of the Nelson's steam trials have not been published officially, they are known to have been very successful. The contract output of 45,000 shaft horse-power was attained with ease, the maximum speed on the measured mile being well above the stipulated figure. The Nelson has proved to be an exceptionally economical steamer, which fact, taken in conjunction with her large fuel-oil capacity—4000 tons—guarantees her a radius of action much greater than that of any previous battleship. The sister ship Rodney, which has returned to the Mersey to be made ready for commissioning next month, has also undergone very satisfactory trials, her highest speed exceeding the Admiralty's expectation by a considerable margin. The trial performances of both ships reflect credit alike on the designer—Sir E. T. d'Eyncourt—the builders, and the manufacturers of the machinery. It may be recalled that the Nelson was built by Armstrongs, the propelling machinery being supplied by the Wallsend Company; while the Rodney was both built and engined by Cammell Laird.

A Great Western Engine in America.

THE Great Western Railway Company's fast passenger locomotive King George V., designed by Mr. C. B. Collett to haul the Cornish Riviera Express single handed, was shipped a few weeks ago to the United States for exhibition in connection with the Baltimore and Ohio Railroad's centenary celebrations. On Monday of this week it was given trials over that railroad's lines. With seven cars behind, including a dynamometer car, it was run by an English driver and stoker from Baltimore to Washington and back and from Baltimore to Philadelphia and back. The trials were attended by Mr. W. A. Stanier, assistant chief mechanical engineer, and other Great Western officers and by a number of American railway officials. It would appear that the performance of the engine surprised and pleased the American engineers.

The Cunard Steamship Company.

AT a meeting of the Cunard Steamship Company, held at Liverpool on Monday last, October 17th, it was decided by resolution to increase the authorised share capital of the company by the creation of 1,100,000 new ordinary shares of £1 each. The resolution will be confirmed at a second meeting of the company which will be held on November 1st. In supporting the proposed increase of capital, Sir Thomas Roydon, the chairman of the company, remarked that the ordinary capital of the company, even taking into account the suggested increase, was not unduly high in relation to the value of the tonnage owned. The total value of the ordinary capital as now issued did not, Sir Thomas stated, even represent the combined cost of one express liner and one steamer each of the 600ft. and 520ft. classes. The Cunard fleet, he further said, now comprised three express liners, five 600ft. vessels, one 550ft. ship, and six steamers of the 520ft. class. Although the cost of a modern Atlantic ship was an extremely high one, it was not the intention of the Cunard Company to remain content with what had already been achieved, and one of the first steps to be taken to meet possible future developments was to broaden the financial basis of the company. With the proposed increase in capital, interest has again been revived in the probable early construction of a new fast Cunard liner, for which, it is understood, plans already exist.

An American Diary.

No. XIII.*

Cleveland and the Avon Station.

A very pleasant way of getting to Cleveland from Detroit is to travel by one of the Great Lake steamers, which ply to and fro across the end of Lake Erie. They are remarkable vessels propelled by paddles driven by three-cylinder compound inclined engines. The draught is limited, we believe, to 16ft., and, in consequence, the vessels are nearly all superstructure. Their high upper-works tower up from a hull with relatively little freeboard, and give them that strange appearance which has been made familiar in this country by many pictures. But if the exterior is remarkable, the interior is stranger still. All the vessels—it was on the City of Cleveland, 440ft. long, that we travelled—are characterised by an immense saloon, in some cases as much as 100ft. long by 30ft. wide and 30ft. or more high. It is, in fact, a huge well surrounded at mid-height by a gallery upon which are situated a great number of state rooms. Behind these state rooms are yet others, for, apart from the saloon and other public rooms, which occupy the greater part of the centre, the vessel is entirely given up, as far as the passenger accommodation is concerned, to cabins ; and very comfortable they are. The furniture and decoration are of a highly ornamental kind, and gilt has been distributed with a lavish hand.

The engine-room is enclosed in a hatch with large plate windows, so that the passengers, after they have provided themselves with "candies" from an adjacent stall, may watch the huge and stately cranks making their leisurely revolutions. We must confess that after a surfeit of turbines—surely the most secretive and reticent of all prime movers—we found a novel pleasure in gazing at real engines once more, engines which, however much they are unlike those to which he was accustomed, might have moved McAndrew to turn hymnologist once more.

Of the vessels belonging to the D. and C. Lake Lines, that of which the company is proudest is the City of Detroit, which is 550ft. long, with a hull 58ft. wide and a moulded depth of 23ft. 6in. The superstructure overhangs the hull, so enclosing the paddle wheels, and the total width is 100ft. The wheels are 32ft. 9in. in diameter, and have eleven feathering floats, each 14ft. 10in. long by 5ft. wide, made of curved steel. They make thirty revolutions per minute, and give the vessel a speed of 22 miles per hour. The engines, an admirable job, have a single high-pressure cylinder of 66in., flanked by two low-pressure cylinders of 96in.; the stroke is 108in. The valves on the high-pressure cylinder are poppets, but on the others they are of the Corliss type. We are told that this is the largest Corliss engine ever built. The boilers are Scotch, with superheaters and Howden's forced draught, and work at 167 lb. The City of Detroit, we may add, was built by the American Shipbuilding Company, at Lorain, Ohio, and was launched in September, 1923. We believe that both the ship and the engines were designed by Mr. Frank Kirby, who is well known in Europe in connection with ice-breaking steamers.

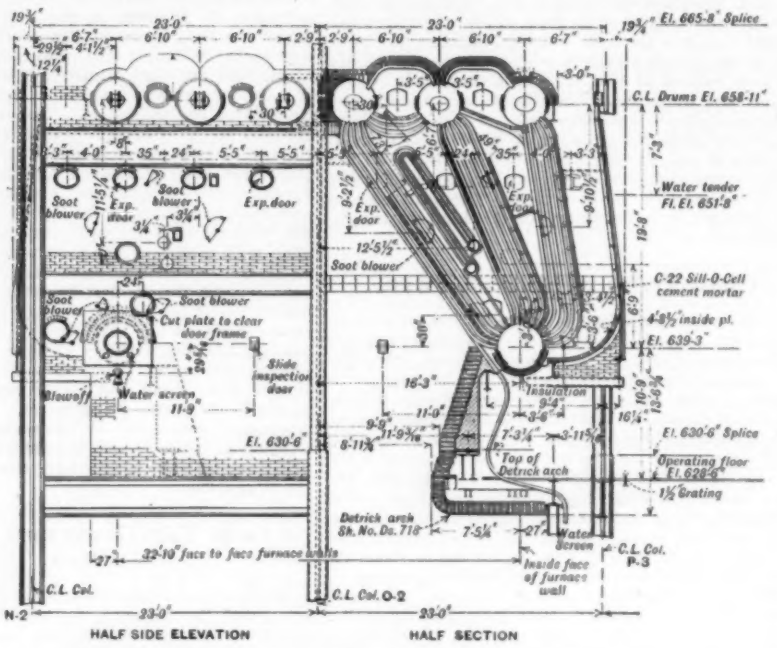
There are many things which one might see in Cleveland, but unfortunately our itinerary—laid down to the minute by the tyrranical collusion of George Orrok and a representative of the Pennsylvania Railroad Company—would permit us to spend no more than a day there and it had to be devoted to the Avon—in America they put the accent on the second syllable—power station. To reach it one travels away from the city by the Lake Shore Electric Railway, a primitive kind of railway or an exalted tramway, which meanders through peaceful suburbs and open country to we know not where, for at "Stop 65" Avon is situated, and there we got down.

Avon is a pleasant station only at the beginning of its career, for it has at present no more than two units. It is very clean and spacious and the free use of aluminium paint, even on the steam pipes, gives it a distinctive appearance. It has no remarkable characteristics, being just a fine example of a powdered fuel station with 375 lb. boiler pressure and a steam temperature of 700 deg. Fah. It stands upon the banks of Lake Erie, and is interconnected with its elder sister the Lake Shore station of the Cleveland Electric Illuminating Company. The present turbo-generators are rated at 35,000 kW each ; there is already provision for two more of the same size, but the projected capacity of the station is 300,000 kW. One may safely anticipate that, as in other power houses, the units will get bigger and bigger as they increase in number.

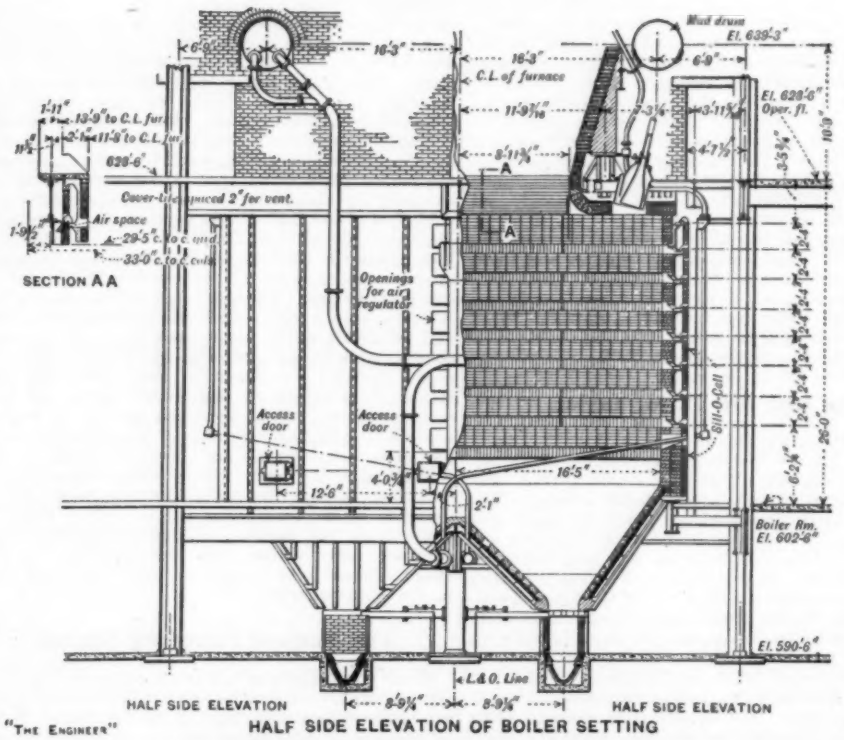
Many of the large stations we visited were situated in the heart, or environs, of large cities, but Avon is in the open country, and it was pleasant to observe that the grounds around it had been, as they say on the other side, "landscaped," so that it might clash as little as might be with its surroundings. From the architectural aspect, it presents a fine block with a simple, but dignified and harmonious, front. But it must not be regarded as wholly exceptional on that account, for in all the recent stations which we were fortunate enough to visit, a good deal of care had been paid to the architectural effect. Happily, Great Britain has not been negligent in that respect, and it may be very sincerely hoped that in the design of the new power houses which are to arise under the impulsion of the Electricity Commissioners, competent architects will be engaged, and that Sir Reginald Blomfield will not limit his attention to the design and colour of transmission-line posts. Indeed, the super-power house offers new scope for the imaginative architect, for, of necessity, it must be of large size without excessive height, and must incorporate certain elements, the chimneys for example, which in the hands of an artist might lend themselves to artistic treatment. We do not suggest any vain and uneconomical effort to copy Tudor designs in the construction of the shafts. They must remain simple, but much might be done, within the limitations laid down by the mechanical equipment which the building contains, to employ harmonious proportions and to avoid the use of conflicting materials. No one can pretend that a plate steel chimney is in keeping with a handsome building in brick, concrete or stone.

Coal comes to Avon by rail. The wagons enter an enormous tippler which turns them upside down, emptying them into a hopper from which elevators run to the top of a mill house. Thence the coal descends through steam heater driers to impact mills which pulverise it. The powder passes through cyclone separators and is raised by screw elevators to weighing tanks, and thence by a screw pump and compressed air to 80-ton "ready-use" bunkers. It descends by gravity to the burners, and is blown in by the primary air.

The boilers are of the twin Stirling type—not the W type which we have seen in other stations. We give a drawing of them and their furnaces, as they afford an excellent example of modern American boiler practice. It will be observed that the furnace is not provided with water walls, but the water screen, running at a slight angle across the upper part of the ashpit, will be noticed. The secondary air is heated in the walls and enters the furnace at the sides. The volume of each furnace is



SIDE ELEVATION AND SECTION OF BOILER SETTING



SECTIONS THROUGH BOILER AND FURNACE AT AVON STATION

* No. XII appeared October 14th.

30,600 cubic feet. The boilers have economisers, but no preheaters for the air. Indeed, when the elaborate boilers at other stations are recalled, these appear to be exceptionally simple—yet they are as recent as any we saw, having been in use but one year. In one other respect their simplicity makes them differ greatly from others; there is at present no provision for trapping the ashes, which are allowed to issue in a visible cloud from the stacks. How long that will be permitted to continue, we cannot say, but a very simple sum in arithmetic shows how impossible it will be when the station reaches its full capacity of 300,000 kW. Let us assume for the sake of argument that 1 lb. of coal is burnt per kilowatt per hour, and that the station works up to capacity for ten hours a day. We may also assume that the coal contains 5 per cent. of ash and that 80 per cent. of it now escapes into the air; in other words, for every 100 tons of coal consumed, no less than 4 tons are scattered in impalpable powder over the landscape. At full capacity 5·3 tons would be sent out per hour, or more than 375 tons per week, or very nearly 19,500 tons every year! It may be said that that is really not a great amount when the area over which it is spread is considered. That must depend upon conditions; of which one of the most important is the direction and strength of the prevailing wind. If the wind carries them far out into the lake, little harm will be done; if, on the other hand, it deposits them in a relatively narrow belt on the land then we may safely assume that means for preventing their emission will be adopted.

We have alluded in our notes on Trenton Channel to the loss of powdered fuel from the bins and crushers. The same loss is being experienced at Avon, and we were shown drawings of an ingenious circuit by which the bulk of the now wasted coal will be returned to the burner feed pipes.

After this slight digression, we may return for a moment to the boiler plant. The normal working pressure is 390 lb., and the temperature at the superheaters 725 deg. Fah. Each boiler has 30,600 square feet of evaporating surface, 6550 square feet of superheater surface, and 21,120 square feet of economiser surface. The area of the water screens is 792 square feet. Each boiler will evaporate up to 340,000 lb. per hour.

We noticed particularly in this station that the gauge glasses were practically invisible from the main operating level. All the other gauges are brought down to the main floor, but, in general, little care is taken whether the glasses are visible or not in American stations. They can be seen, but not with ease. But at Avon, and also at other stations, one member of the watch—they only number four in this house—parades a gallery at steam drum level, and, of course, keeps his eye on the gauges. At Avon, as at all the other stations which we inspected, the arrangement of the gauges is admirable. They are either grouped near the fronts of the boilers or on special stands arranged in the centre of the operating floor. In either case they are of large size and can be read easily by the boiler-room staff.

The turbine room is quite a pleasant place to be in. The walls are faced with harmoniously coloured bricks, the floor is tiled in red, and the rails, doors and other details are in a green bronze tint. The whole room, indeed the whole station, is cool and airy. In common with most other stations, the turbine floor is reserved wholly for the turbines, all the auxiliaries being below it. It is 216ft. long by 100ft. wide. The two turbines now in use are General Electric single shaft machines, seventeen stages, with a speed of 1800 r.p.m. The generators generate three-phase current at 13,200 volts and 60 cycles. The condensers, Worthington, are horizontal, for the water is good. They are single-pass, have 42,000 square feet of cooling surface, and are served by two 43,500-gallon circulating pumps. As far as we can recall, these were the only condensers which we saw which were fitted with high-pressure water jets for cleaning the tubes. The jets are arranged in spherical joints in the doors. We believe they have never been used; and we have been told that they won't be much use when they are used, for the slimy growth which attaches itself to condenser tubes is not easily scoured away.

We may take this opportunity to mention a form of grating for boiler-room galleries, which is very common in America, and is not unknown here. It is made up of steel strip set on edge, bent and riveted together to form a trellis pattern. It is very light and lets lots of air through. One can see through it from top to bottom of the boiler house.

To be continued.)

Characteristic Furnace Curves as an Aid to Fuel Control.

By H. C. ARMSTRONG, Assoc. M. Inst. C.E.

SLOWLY but surely it is being realised that the study of the problems of fuel economy is of real importance. Great strides have already been made in the right direction, but unfortunately less in Great Britain than elsewhere. So far, practical application of the scientific thought expended is still largely wanting and, especially in our large industrial concerns, only the threshold of the proper realisation of the necessity for correct control by qualified hands has been reached.

Heat plays a part of enormous importance in many industries. In none more so than in the iron and steel industry, which during 1924 in Great Britain consumed about 24¼ million tons of coal, of which about 10 million tons were used apart from blast-furnaces. It has been estimated that as much as 35 per cent. of the cost of steel manufacture is accounted for by fuel.

In these circumstances close attention must obviously be paid to fuel control, and in the following article the author suggests a method by which accurate and careful control of furnace heating can be effected.

Hitherto there has been some difficulty in making comparison between the practice of one country and another, or even between neighbouring concerns. Figures, apparently extremely favourable, are often quoted, but when they are compared, it is found that conditions are so different as to render them of little value. Charged with the task of controlling the fuel in some large steel works in the Sheffield district, the author was immediately struck by the fallacy of the almost universal practice of using fuel burnt per ton of product as a comparative figure. For the fuel burnt per ton, a figure which represents the best practice is usually given. Any other result is brushed aside as being obtained under unsatisfactory or unusual conditions.

What unit, then, can be usefully employed? Thermal efficiency, apparently an ideal basis for getting at the behaviour of a furnace, varies with the load carried in the furnace. Furnace efficiency—that is, the percentage of the heat in the fuel used actually put into the material heated—varies from 5 to 30 per cent. The latter figure is only obtained in extreme cases, such as town gas-fired furnaces with high recuperation, and in metallurgical furnaces of the "in and out" type, such as are largely used in Sheffield, thermal efficiencies of as low as 5 per cent. are the rule rather than the exception. Even continuous billet heating furnaces reach less than 25 per cent.

Such figures as these make it clear that there is much to be gained by a close study and careful control of combustion in steel works. Graphs can be advantageously employed to help in the control of all furnace operations, although very little has been done with them hitherto: perhaps on account of so little thought having been given to such operations. Their use will now be discussed, but before putting forward a method for drawing them up, it will be well to consider briefly what actually happens when a piece of metal is being heated.

The curves in Fig. 1 give an idea of the heating cycle of a 30-ton steel ingot in a simple coal-fired "in and out" forge furnace. They show the results of a careful test carried out by a research department. Curve 1 gives the temperature of the furnace gases; curve 2, that of the outside of the ingot; 3, 4 and 5, the temperatures 1ft., 3ft. and 5ft. from the end. Curve 5 may be taken as that of the inmost portion of the ingot which must eventually arrive at the correct forging heat. The ingot was charged cold into a furnace at 600 deg. Cent.

The temperature of the furnace gases at any moment is dependent on combustion conditions. At first the chilling effect of the mass of the cold material upon the gases tends to prevent or retard combustion of the volatiles from the fuel and to cool the gases. After about five hours this cooling effect is considerably lessened. The outer surface of the stock, although not quite up to full forging temperature, at this point is highly heated, and further time is chiefly required to allow such heat to penetrate or "soak" into the interior of the ingot. The gases have then arrived at, and remain at, a more or less constant temperature which is largely dependent on the amount of excess air present. This is fixed by the design of the furnace and the class of fuel. The resultant temperature cannot be exceeded—that is, there is a maximum temperature to which the furnace can be heated and no amount of fuel burnt can increase it.

Curve 2 shows irregularities which are more apparent than real owing to the fact that the radiation from the gases affects the pyrometer more quickly than it does the actual ingot surface.

Since all heating depends upon the temperature differential between the hot and cold bodies, the rate of heating of the material is governed only by such temperature difference. Heat flows from the hot gases to the roof, walls and ingot. As long as sufficient heat units are supplied from the fuel to the hot gases to compensate for such loss—that is, to keep the upper curve constant—heating will continue at the highest possible rate. Should additional heat units be evolved by a still greater consumption of fuel, they can only pass forward as waste. Hence the object of the furnacemen should be to use only sufficient fuel to attain the result indicated by these curves. That is, to keep the upper one at its maximum flat rate. This fact explains why pyrometer-controlled furnaces do not waste fuel to anything like the same extent as those driven haphazardly.

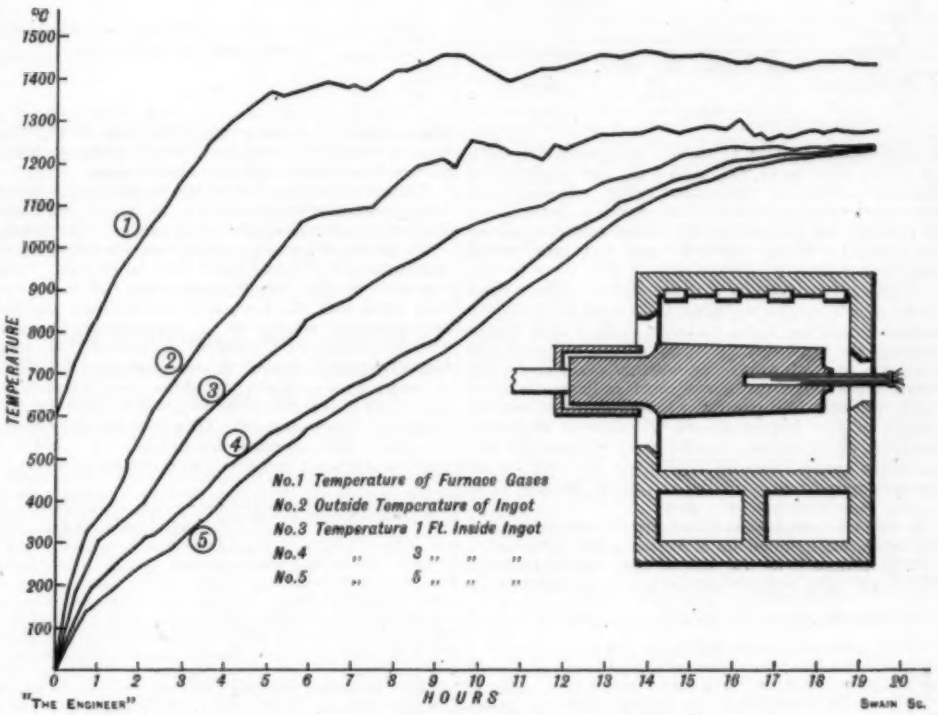


FIG. 1—CURVES SHOWING HEATING CYCLE OF A 30-TON STEEL INGOT

From the preceding remarks it is easy to see that by checking the amount of fuel burnt over any period or heating cycle, a constant can be arrived at, which, under control, can be fixed and watched. When keeping count of operations week by week for a large number of furnaces, the author noted that not only, as one would expect, is there little difference in the fuel burnt over any period for similar heats or furnace loading, but that over a very large range of output there is a comparatively slight difference in the rate of fuel consumption. In many cases the difference is insignificant. Here then is a very simple unit to one's hand. The fuel burnt per hour is easily reckoned and, as a practical means of control, is a highly reliable guide.

The operating efficiency of any furnace can be checked from a "characteristic" curve drawn to illustrate the above facts by plotting the output per furnace hour against the fuel per hour, or, if preferred, the fuel burnt per unit of output. The essence of furnace control is to keep the *fuel per hour*—if the hour is to be the unit of time adopted—as low as

possible. This may be represented graphically for any furnace as in Fig. 2.

Here it is assumed that the furnace is working at a constant temperature for all heats, and therefore is losing a fixed quantity of heat by radiation. A constant amount of fuel must be burnt to overcome this loss whatever the loading, and, in consequence, a large amount of heat is carried away by the waste gases. The horizontal line AB will, then, represent the fuel that must be burnt to keep the furnace up to its proper temperature, independent of the loading. More fuel must be burnt to heat the charge, and one would expect the quantity to be proportional to the quantity heated. The hatched portion on the figure represents this additional fuel. AC will then indicate the total fuel required at any loading. This, for practical purposes, may be considered a straight line, and it also gives an indication of the effect of loading on the thermal efficiency of the furnace.

As previously mentioned, the fact that curves of this nature can be drawn for every furnace has been proved by the author as the result of several years' experience in keeping records of all types of furnaces.

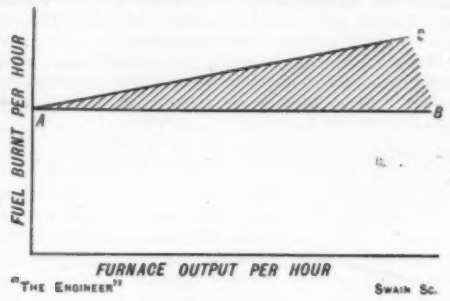


FIG. 2

It is a simple matter to obtain the necessary data *i.e.* :—(1) The total fuel used; (2) the quantity of material heated; (3) the furnace hours. These should be weekly returns and be made with as little delay as possible, so that errors may be checked, and any variation from the basis be inquired into before forgotten.

With very few results it is possible to draw a basis curve which can be re-drawn from time to time, the author's practice being to begin with a line drawn through the best points that have been achieved and improve on that as results warrant. As any fresh result lower than the curve must indicate less fuel used, not only is it possible to stop wastage, but the results of any improvements, whether in design or methods of firing, are immediately noticeable, and complete control can be kept, week by week, of all furnace operations as easily as similar work is done in any repetition machine shop.

It must be emphasised that the different nature of the work being done in a furnace only affects the results insomuch as the output per hour is affected. One week, light hollow forgings are being heated; the

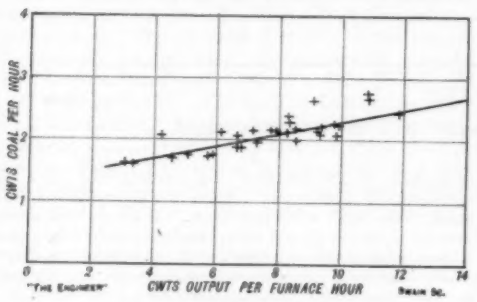


FIG. 3

next, heavy large ingots are cogged. That means a large difference in output, but a small difference in fuel per hour, and the results can be compared by their position on the curve. Cranks, which require replacing in the furnace several times, take a very different number of heats from marine shafting, with correspondingly large variation in output. They both require definite amounts of fuel per hour, which must lie on the same curve for the same furnace. A hammer breaks down and the furnace is kept going while repairs are made. The fuel per hour goes on just the same and can be watched. Hitherto, in such cases it has probably been said that the fuel figure must be bad, hence, it is no good taking notice of that week.

Figs. 3 and 4 show actual results obtained from two furnaces, both coal fired. It must be borne in mind that these and the other curves are drawn from shop returns, the accuracy of which is not that of scientific tests. Bunkers are kept to the same level at the end of each week if possible, but irregularities creep in. The "law" of these curves becomes all the more striking. In practically every instance where a point falls considerably outside the curve, a special reason was forthcoming.

Fig. 3 illustrates the records from a furnace annealing steel castings. Fig. 4 shows the results obtained in a furnace heating billets or ingots for forging a hammer. The straight line law shows up very clearly in both. It will be noted that in the latter case the output of the furnace is trebled for an increase in the hourly rate of fuel of only about 12½ per cent.

Although in all fuel control systems use should be made of the *fuel per hour* figure, that is not the most useful method for the shop manager. If the same weekly results are plotted as fuel burned per ton against output per hour, an hyperbolic curve is obtained, which both gives the manager a means of watching his weekly results, and shows the importance of keeping the output high in order to reduce the fuel cost per ton as much as possible. Charts drawn upon these lines can be hung in the office, and each week's results can be plotted for all concerned to see. When this is done, fuel is regarded in the proper perspective. Without some such method, everything is often subservient to "labour charges," and coal costs are relegated to the background as of little importance. Although the cost of fuel for a

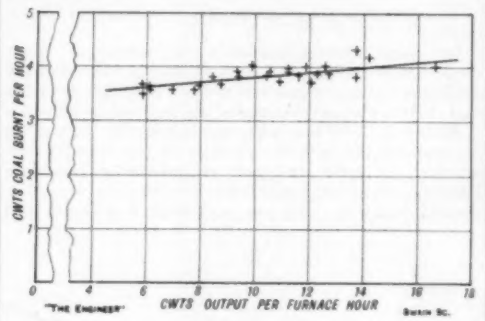


FIG. 4

process may be equal to anything from 25 to 100 per cent. of the skilled wage cost, the two items are always viewed from totally different standpoints.

The curves in Fig. 5 show the results from a furnace before and after fuel control by means of this system. The saving shown on the lower curve is very marked.

To obtain absolutely true curves, the throughput of the furnace or weight heated must be plotted. Owing, however, to the fact that the fuel per hour varies very little with the loading of the furnace, the curve approximates closely to a rectangular hyperbola. The proportion of "finished production" to weight heated in a week is more or less constant. The method of obtaining the weight heated becomes of less importance, and it is sufficiently accurate to plot the "production" figure instead. This obviates the necessity of taking into account the number of times a job may be reheated and saves a considerable amount of

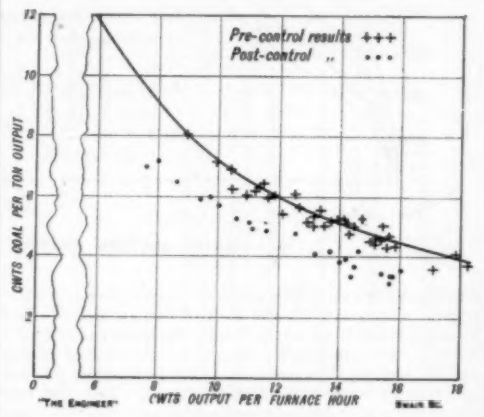


FIG. 5

clerking, a very necessary consideration when advocating any additional method of control in a works.

Finished weights are used in Fig. 6, which shows the results from a reheating furnace serving a very large hydraulic press following an alteration to the furnace when rebuilding. It will be noted that the results lie very close to the hyperbolic curve drawn through the two extreme cases. The low output was the result of making special light hollow forgings which required several reheatings for each forging. The highest return was due to heavy forgings, which required comparatively little work done on them, being made.

Fuel consumptions varying so greatly as 39·5 cwt. and 5·0 cwt. per ton are thus strictly comparable, and any subsequent improvement or falling off between these limits can be readily ascertained.

Where the class and quantity of material passed through a furnace varies little, the work entailed by this system may appear unnecessary. Even in these cases the fallacy of only working to the fuel per ton must be guarded against. One constantly hears particularly low figures of fuel per ton quoted. Such figures are never comparative unless the output is also taken into consideration.

Furnace Testing.

A word may be said here on furnace testing. The combustion engineer should be responsible for the testing of all new plant installed, but it is of considerable assistance to run occasional tests of at least a week's duration and under working conditions. Furnace builders are only human, and in many cases their guarantees are dependent upon best loading conditions and are even somewhat elusive. As already mentioned, furnace loading has a very misleading effect, and hourly consumption should be the deciding factor.

Some time ago, the author obtained some very interesting information on furnace working through comprehensive tests carried out over several days at a time. The furnaces were coal fired, and the unit of firing taken was a shovelful. The furnace loads and positions of the dampers were noted, and a continuous record was taken of the temperatures of the flue gases and of the gases leaving the waste heat boilers where fitted.

One of these tests is shown diagrammatically in Fig. 7. The furnace under observation was a small coal-fired furnace heating tire blanks for the hammer. There was no boiler attached to the furnace in this particular case. The men were allowed to work in their usual way and no instructions were given as to the working of the furnace. Hence the results are not shown as ideal, but much useful information was gained and economies were introduced as the results of the better methods of firing subsequently adopted. Most noticeable in the tests, as will be seen from the diagram, is the more economical firing of the fireman

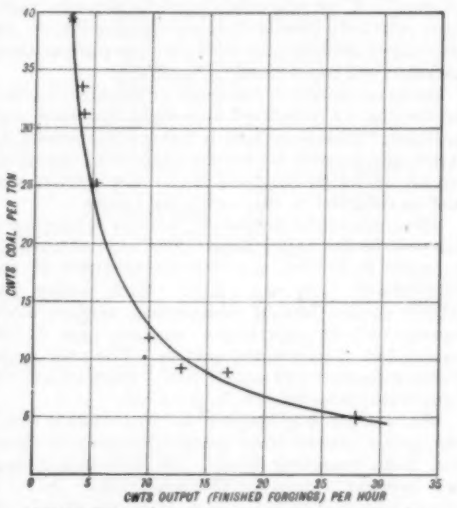


FIG. 6

on the morning shift—although the amount of material heated on the other shifts was slightly less—and the amount of green coal thrown on to the grate after cleaning the bars.

Improvements to be Looked for in Furnace Design.

The greatest loss in any furnace is the heat leaving in the flue gases. Regenerators are costly and entail deep foundations and expensive valve gear. With raw coal they are not possible. What is needed is a simple recuperator to enable a large part of the heat lost to be returned in the form of heated primary and secondary air. It is not possible to pass heated air through burning coal without means being taken to avoid excessive temperature on the grate and to prevent burning the fire-bars. A metal for bars capable of standing such conditions is at present of prohibitive cost. Certain designs overcome this difficulty by passing steam or water through the grate. If it is necessary to cool the bed to prevent excessive clinkering, it seems somewhat incongruous to preheat primary air and then deliberately cool it off with water vapour.

Damper and air control must be made simple and arranged to be worked from the furnace front. Usually ill-fitting and crude, it is placed anywhere as if as an afterthought. Neglect of this important item can only lead to waste of fuel.

There is a large field for investigation and improvement in the matter of furnace insulation. All engineers realise the necessity of lagging steam pipes, although in many places pipe flanges are left uncovered. The necessity of using insulation material round furnaces has not been appreciated. With bricks made of diatomaceous earth, radiation losses through furnace walls, &c., which may reach 20 per cent. in extreme cases, can be largely reduced. It is a simple matter to show that the result is worth the extra initial cost.

The size of furnace is of some importance. If it is realised that the amount of fuel burned to keep the furnace up to heat is much greater than that taken by the stock, it is apparent that furnaces should be as small as possible for the required work. Often in a shop where the work varies in size, all furnaces are built to take the largest job. It were better to have a special furnace for such duty, and to keep down

the normal fuel figure by using smaller furnaces for the most work.

A few years ago a craze arose for steam-blown furnaces. There are few furnaces working anywhere that are not called upon for greater outputs than was intended in the original design. The steam-blown furnace, "which will get the furnace hot quicker" was the result of this demand. A steam-blown furnace allows of a quicker rate of fuel consumption per square foot of grate area; nevertheless, although the result is apparently a better furnace, the thermal efficiency is low. Fires are usually too thick, and it is impossible

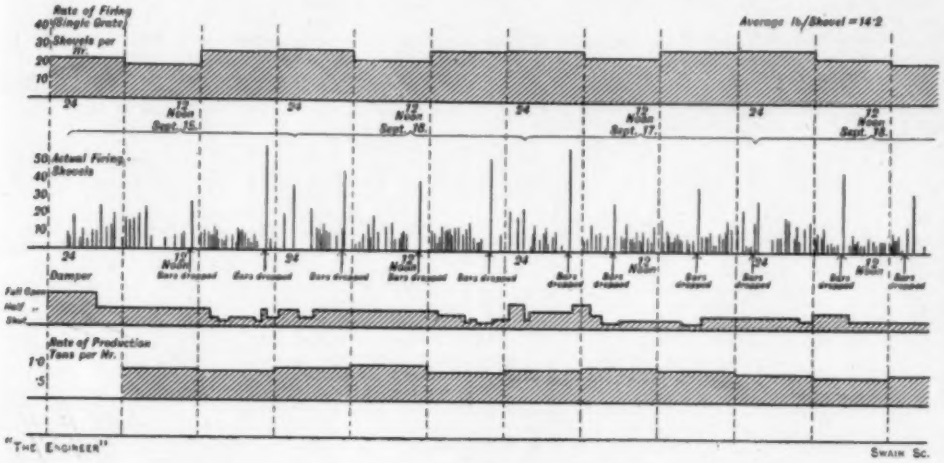


FIG. 7

to pass through the grate the whole of the air necessary for complete combustion. Ideally, some 34 per cent. of the total air required is necessary for primary burning and the remainder for secondary. In actual practice a much larger amount is necessary for the combustion which takes place in the fire-box. The speed of the gases through a steam-blown fire is high, the time and the amount of air passing through is insufficient for the greater part of the volatile constituents driven off to be burnt and excessive smoke is caused. Secondary air, which should be heated, is very necessary. In practice the designer of the steam-blown fire appears to have overlooked this. Little has been published about the behaviour of steam-blown air and the design of the correct blower. The amount of air carried forward by a constant quantity of steam falls off rapidly with increased ashpit pressure. Thus the air is easily affected by variations of the fire-bed resistance caused by the thickness of the fire. When firing is heavy, the resistance increases and either insufficient air is passed or an excessive amount of steam is used. Considerable amounts of steam can be consumed unchecked, and are often overlooked when computing the fuel used to heat the stock. In the majority of cases somewhere about a ton of steam is used per ton of coal burned.

The design of the coal-fired furnace has probably been neglected on account of the prevalent opinion that gas-fired furnaces are cheaper to work. It is too readily assumed that the latter must be the more economical, but fuel wastage can and does occur at the gas producer. Whatever the merits of powdered fuel or gas, the author would suggest that there will remain, for a considerable time, a large field for furnaces fired with raw coal. Coal furnaces have the merit of being very elastic, and have several points in their favour. Oils and smokeless fuels may be very valuable as such, but if they have been produced from coal in the first instance are only sources of heat energy. It should be possible to utilise the major part of this energy in a properly designed furnace —perhaps with waste-heat boilers—without the preliminary heavy charges of splitting up in carbonisation processes.

Much has been said for and against waste-heat boilers as an adjunct to furnaces in iron and steel works. Connection with a steam accumulator would obviate many of the chief objections to the waste-heat boiler. Steam raised by the waste-heat gases and produced over those periods when the furnace is heating and steam demand low, can be stored for use elsewhere. Such possibilities open up the field very largely for the better use of waste gases. When it is considered that the addition of the waste-heat boiler may quadruple the thermal efficiency, the question becomes of considerable importance.

CONCLUSION.

In conclusion, it is hoped that this article may have helped to direct attention to the importance of fuel control and of definitely handing over the complete control of all fuel problems to some specially appointed person.

Fuel economy for some time must consist of a large number of very small savings rather than any revolutionary introduction of new methods of heat production. The individual saving on any one furnace in a week may appear small, but 10 to 15 per cent. saving on the works coal bill represents a considerable sum at the end of the year. In both France and Germany, where special attention is being paid to all questions of fuel control, 15 per cent. and higher saving has been definitely accomplished.

It is evident that, for several years to come, at any rate, whatever economies can be effected in the working of our coal mines, all such moneys will be divided between the miner and the mines. No important reduction in price of coal can be looked for. Must we not then turn our attention to reducing the effectual price to ourselves by the comparatively simple method of more efficiently burning the raw material in our works and industries. The author would suggest that the latter method must offer the true solution of our coal problem, or at least go a long way to help us to recover our lost position in the world's markets.

Finally, the author would like to express his thanks to the directors of John Brown and Co., Ltd., and Thos. Firth and Sons, Ltd., for their permission to publish this article, and to Messrs. Gray and Bailey for their help in obtaining the necessary data.

The Economic and Social Development of the American Iron and Steel Industry.*

By THEODORE W. ROBINSON, Vice-President, Illinois Steel Company, Chicago.

THE social and political character of any nation is largely dependent upon the extent of its economic welfare, and the prosperity of all classes of its people is contingent upon the prosperity of its basic industries.

Because iron and steel directly or indirectly enter into every form of human activity and touch the life of every civilised human being, the conditions surrounding its manufacture mirror to a marked degree those of business in general. This is particularly true in the United States, which has enjoyed unusual industrial activity during the last few years. A description, therefore, of some of the more important changes that have affected the manufacture of iron and steel may well serve not only as a text of the progress of the industry itself, but as a means of illuminating some of the reasons for American prosperity as a whole. If this contribution helps toward a better understanding of an economic and social situation which during the last few years has been a source of widespread interest and investigation, its purpose will have been achieved.

Because of its subtlety current change needs time and distance for a proper perspective, and for the better comparison of the development of the United States in recent years a chronological base line has been established at the ushering in of the twentieth century. While this discussion is thus specifically concerned with the development of the last twenty-five years, the prelude of an earlier background may throw into stronger relief some of the conditions and forces that are in play to-day.

As late as 1860 manufacturing in the United States was chiefly confined to comparatively small units located in the communities that fringed the Atlantic seaboard. Transportation was slow and costly, and distribution was largely for local consumption. Industrial ownership lay in the individual, partnership, or small corporation, and there was close contact between men and management. Wages and output were low, luxuries few and far between, and standards of living were relatively simple.

Then came the epoch-making pneumatic process for making steel. It was the beginning of the industrial revolution which has made America the great workshop that it is to-day. The iron and steel industry was quick to grasp the possibilities of the new process, and steel plants began to spring up here and there throughout the country. By the Bessemer rail the Far West was opened, and the North and South were tied together. For thirty years unparalleled expansion followed the rapid development in railway construction, and men swarmed to American shores in response to the call for labour.

By 1880 manufacture was rapidly forging to the front. Individual ownership of the shop was giving way to the small corporation, and the small corporation to larger aggregations of capital. The former employer was becoming the employee, and there was less personal touch between owners and workmen.

With better and more extensive transport facilities industry became more highly centralised, and rural life was replaced more and more by urban life. The relative crowding of industrial centres helped to accentuate the change from former standards of living and the transition was not always conducive to contentment and well-being. Factory conditions were crude and too often unsanitary, and the physical hazard of industry rapidly grew through the increased installation of power and machinery.

A class consciousness developed to an extent unknown before. The country was becoming richer, and with increased wealth capital was prone to be more intolerant and labour more independent, while both gave less heed than formerly to the power of public opinion; but in spite of these throes of a new industrial birth the country continued to expand.

In reviewing this period it is clear that the underlying reason for the remarkable progress made in the twenty-five years following the close of the Civil War in 1865 was the introduction of the Bessemer process. No single industrial invention ever had such a vital and far-reaching effect on the commercial and social destiny of any nation as this new steel-making process had upon the United States. The first Bessemer ingot made in the New World was produced at an experimental plant at Wyandotte, Michigan, in 1864, but steel did not begin to be an important factor in the replacement of iron till ten or fifteen years later.

When the Illinois Steel Company was organised in 1889, with an authorised capital of 25,000,000 dollars, by the combining of three important steel-producing companies in the Chicago district, it was properly heralded as an outstanding feat of corporate development. It represented at that time the most forward step in individual control of pig iron and steel-producing plants, but even in this case the company lacked complete operation, and had largely to depend upon outside parties for their ore and coal supply. As with other large steel producers in that period, the finished product chiefly consisted of rails, while the blooms and billets, which mainly made up the balance, were but the raw material for finishing mills belonging to other interests.

The following ten years from 1890 to 1900 were momentous in their import to the country, and were fraught with consequences that were fundamental in their influences upon the present life of the American nation. This period recorded the true beginning of big business, and iron and steel again played the most important *rôle*. The first seven years of the decade beginning with 1890 were lean and hungry. The necessity of rigid economy was emphasised by the severe industrial depression that existed. Liquidation became general and drastic, and by the time the pendulum swung toward brighter things the country was ripe for the saving and profit that lay in combination.

In 1898 the Federal Steel Company was formed with an authorised capital of 200,000,000 dollars. This brought under one management ore, coke, iron, steel and transportation, to an extent only approximated by the Carnegie Steel Company. During this period most of the finishing mills throughout the country were brought together into large units, and they controlled in their separate entities the wire, tube, tin-plate, hoop and sheet steel products of the country.

Such consolidations in iron and steel were largely typical of the change that was taking place throughout the manufacturing industry as a whole. It was a time of feverish activity. Promotion was rife, business ethics were low as compared with present standards, and as a result of public mistrust there was a marked change in Federal and State legislation from one of permission to one of restraint.

The Dawn of the Twentieth Century.—The twentieth century opened auspiciously for the United States amidst long deferred prosperity. The rapid progress made in the period just reviewed was founded upon new processes and new methods, distinctly technical in their character, which followed the introduction of the manufacture of steel.

The progress during the last twenty-five years, however, has been more essentially the result of social and economic change. Its history is a story of a nation adopting and assimilating the principles of big business; of the mobilisation of its capital and credit through the Federal Reserve system; of increasing its industrial output through co-operation, integration, and mechanical energy; of developing modern management as an entity separate from owner and worker, and of more equitably dividing among its people the fruits of industry through better opportunity and higher wages. In short, the story of the first quarter of the twentieth century is one of a nation commanding for its people the highest standards of living ever achieved by any nation by the scientific study and application of man and machine.

During the last twenty-five years the income of the United States has nearly doubled, while its population, though largely increased, has grown in a lesser ratio. The significance of these changes lies not so much in the increase in the nation's production of wealth as a whole, as in the surplus purchasing power that has sprung from the increased output of the individual worker. A large family may produce in the aggregate much more wealth than a small one, but if the large family accumulate no surplus, a small family with greater individual productivity and with the same proportionate cost of living may grow rich while the large one remains poor. A vital factor in the development of the twentieth century, and one which has been especially emphasised in the United States since 1914, is the multiplication of individual effort rather than the effort of multiplied individuals.

The United States during the past few years has been experiencing the unprecedented economic condition of continuously falling commodity prices, high wages, and continued prosperity. Any intelligent attempt to explain this anomaly must recognise certain elementary economic principles.

It is clear that wealth cannot be divided until it is produced, and obviously the more there is produced by each workman the more there is to be divided. Wages and dividends are primarily matters of wealth's distribution—not of its production. High wages mean high consumption. The larger the output of the individual workman, the greater is the tendency to lower costs and the greater the possibilities of return in wages and in dividends. Present easy money and low inventory are factors that influence but do not answer the question before us. High wages as a matter of distribution instead

* Iron and Steel Institute, September, 1927.

of production are an effect rather than a cause, and raw material, of which our forefathers had much more than we, is but of potential value until converted.

These are elements that enter into a complex problem, but do not explain it. Neither would increased production if accomplished merely by a proportional increase in the number of workers. The true answer to this economic paradox of combined high wages and lowering prices of goods, and the underlying primary cause of the late industrial progress of the United States, lies in the increased and unrivalled output of the individual American workman, and the large accumulation of wealth that has resulted from it.

The extent of this wealth is indicated by figures recently compiled by the National Industrial Conference Board from Washington statistics. These show that the value of the yearly product of the average workman in all the manufacturing industry of the United States rose from a *per capita* production value of 3214 dollars in 1904 to 4682 dollars in 1925, as measured by the common purchasing power of the 1914 dollar. This represents an increase of 45·7 per cent. in the manufacturing output of the average individual workman, which, if applied to the total volume of manufactured product, signifies that the increase of wealth in 1925, due solely to the increase in *per capita* production, amounted to 12,304,000,000 dollars more than it would have been had the output of the average worker been no greater than it was in 1904; in other words, one-third of all the wealth that was produced that year from the nation's manufacturing industry was directly due to the increased productivity of the average individual workman.

How profound an influence such vast sums have on the whole economic structure of the country is perhaps better visualised when it is realised that twelve and three-tenths billions of dollars, on the basis of present individual production, is equivalent to the output of 2,628,000 men—a number equal to nearly one-third of the entire working force of the United States engaged in the manufacturing industry. That the productive efforts of such a vast army of workers can be laid aside by machinery and management and rendered available for other additional work without an average increase in the country's non-employment is a striking commentary on the stimulating and absorbing effect of increased individual production.

The average output of the individual workman in the United States is to-day greater than ever before, and is much larger than that of any other nation. Canada comes next to the United States in individual productivity, and America finds its antithesis in the archaic industrialism of China.

An explanation of the increased efficiency attained by the manufacturing industry of the United States is found in the development of its iron and steel production. Of all basic industries, the manufacture of iron and steel ranks first in fundamental importance and second in the amount of wages paid.

Production of Iron and Steel.—In 1901 the United States with its output, in round numbers, of 13,500,000 tons of ingots and castings, produced 44 per cent. of the world's steel. This by 1926 had expanded to more than 51 per cent. of the world's total, with its production of over 48,000,000 tons of steel. Whereas twenty-five years ago the steel ingots made in the United States consisted of more than 66 per cent. acid Bessemer, nearly 84 per cent. of the steel now produced is of basic open-hearth. This, in brief, tells the nation's accomplishment for the first quarter of the century, and records the large replacement of the Bessemer converter by the open-hearth furnace, a change superinduced by the changing character of the country's ore reserve.

The causes for this impressive growth, while clearly complex, are largely predicated upon economic and social change rather than upon any pronounced technical difference in method of manufacture. In principle, the blast-furnace, open-hearth, Bessemer converter and rolling mill are still the unchanged agents of reduction and conversion and there has been but little progress made in the fundamental metallurgy of iron and steel during the twentieth century. Momentous advances in technique and the refinement in operation have resulted in an increase of output which can only be partially attributed to a multiplication of plants.

The production records of the past twenty-five years at the South Chicago Works of the Illinois Steel Company furnish a concrete illustration of the effect of such advances. These works represented in 1901, as they do now, the best modern practice. The average daily output of each of the South Chicago blast-furnaces increased from 318 tons in 1901 to 679 tons in 1926. During this period the acid Bessemer department increased its production from 70,000 to 100,000 tons per month, and the basic open-hearth furnaces increased from an average output per furnace of 586 tons per week to 1379 tons per week. The South Chicago rail mill had an average capacity of 60,000 tons per month in 1901, while the Gary rail mill, by which it has been replaced in the rolling of rails, has a capacity of 100,000 tons per month. These figures reasonably illustrate the unit advance in physical production which has taken place in the iron and steel industry in the United States.

A still more important development in American practice is the increased *per capita* output of the average iron and steel workman. This is strikingly illustrated by the following South Chicago records:—

Illinois Steel Company (South Works).

Tons Produced per Man-hour.

	1902.	1926.	Increased percentage.
Ore unloading	2·087	16·835	706·7
Blast-furnaces	0·185	0·698	277·3
Bessemer ingots ..	0·421	0·841	99·8
All open-hearth ingots	0·252	0·418	66·0
Rail mill— South Works, 1902 / Gary Works, 1926	0·189	0·416	120·1

This table shows that the average man in a modern iron and steel plant is producing from one and a-half to eight times as much as he did twenty-five years ago. If translated into yearly volume, these figures indicate that at South Chicago the average workman has increased his ore-handling capacity since 1902 from 6000 to 48,000 tons; his pig iron output from 675 to 2405 tons; his Bessemer ingot production from 1761 to 3730 tons; his open-hearth ingot production from 1049 to 1842 tons; and his rolling capacity from 603 to 1240 tons of rails.

That this accomplishment is fairly typical of the changes that have taken place in like branches of the industry for the country as a whole is supported by data lately published by the United States Department of Labour, which shows an average increase in worker productivity upon a man-hour basis of 165 per cent. from 1899 to 1926 for crude iron and steel products.

These results are impressive when it is recalled that they are based upon actual continuous records running over a quarter of a century in a plant which in 1901 represented the latest development in equipment, organisation and method, and one that during the intervening years has kept abreast of current change.

Such a transformation is essentially due to the enlargement of units, refinement of design, and the installation of labour-conserving appliances rather than to fundamental changes in process. Behind these, however, is the large addition of mechanical energy by which these improvements have been made possible, and at the back of all lies enormous investment and co-operation of men and management.

Power Installation.—The manufacturing productivity of any nation can be roughly measured by the amount of its mechanical energy, and the marked growth of power application in the United States has made possible its expansion and prosperity. From 1899 to 1925 the country's primary horse-power more than trebled, and as a result of this increase there is now 4½ horse-power at the service of every manufacturing wage-earner.

On the conventional assumption that 1 horse-power is equal to the unassisted physical effort of ten men, the average capacity of the individual worker in the United States is more than forty times what it would be if unaided by mechanical energy.

The manufacture of iron and steel has more than kept pace in power installation with the progress made in general industry. During the last twenty-five years its use of power has increased nearly fourfold, and to each of its workmen there is now given the energy of over 16 horse-power.

The extent to which power usage has been amplified and the electrification of plant increased is strikingly exemplified by the Gary Works of the Illinois Steel Company. A short generation ago the reciprocating steam engine was the principal prime mover in both primary and secondary units. At Gary the production and utilisation of power is dependent upon the blast-furnace gas engine, steam turbine, electric generator, and motor. Here 11,716 men were able in 1926 to turn out more than 2½ million tons of finished product, because behind each of them was the electrical energy of nearly twenty horse-power.

Wages and Their Relation to Living Cost.—It is but natural to ask whether or not the increase in worker productivity, in which power usage is such an important factor, has been followed by an increase in "real wages." Wages and earnings in the Chicago district may be considered as typical of those existing elsewhere in the iron and steel industry of the country. In 1901 the daily wage was based on 15 cents per hour, and the average yearly earnings of all employees of the South Chicago Works for that year was 825 dollars. By 1926 the hourly rate had risen to 44 cents, and the average yearly earnings to 1870 dollars, an increase of 127 per cent., or more than double the amount of earnings received before. With this increase in earnings went also a reduction of nearly 18 per cent. in the hours the men were required to work. Prior to 1922 the iron and steel industry had been operated almost universally on the basis of twelve hours for continuous operations, and ten hours for non-continuous operations. In that year the present eight and ten-hour day working schedule was adopted, and several years earlier the seven-day week had been replaced by the six-day week.

In the first decade of the century there was no striking change in the basic cost of living or in the wage scales. By 1914, however, there had become pronounced that vicious circle of high commodity prices, high cost of living, and high wages which a few years before had begun to evidence itself. War conditions aggravated the situation, and commodities, living costs, and wages rapidly pursued one another upward in an ever-expanding sequence until the deflation of 1921. The social and economic consequences to the wage-earner and to industry are told by the following result of governmental investigation. Earnings in twenty-three representative industries increased 115 per cent., between 1914 and 1925. Living costs of workers' families rose 68 per cent., and the hours of labour decreased more than 6 per cent.

These figures indicate that wages in the manufacturing industry have more than kept pace with the increase in commodity prices. The surplus earning power thus represented well explains the present wide consumption of luxuries and the high standard of living that now exists.

Prices and Investment.—Granting that the economic change during the last twenty-five years has been distinctly beneficial to the wage-earner, what has been the contemporaneous effect upon the consuming public and investor?

If we take the price relation that existed between the composite steel price and the wholesale price of commodities in 1913 as a base, we find that whereas in 1901 the price of steel was relatively 52 per cent. higher than that of commodities, it was in 1926 3 per cent. lower. The composite price of steel is now practically 27 per cent. higher than in 1901, while the wholesale price of commodities has increased 99 per cent. Due to efficient management, the spending of many millions in power and machinery, and the co-operation of labour, the consumer, relatively speaking, is buying steel now cheaper than he did twenty-five years ago.

With the investor of to-day it is a somewhat different story, and this is specially true if there be borne in mind the difference in the amount of money represented by capitalisation upon which dividends are paid, and the much larger sum that is represented by the balance sheet, and upon which earnings are dependable.

While there are from the Government no exact figures of the amount of money that is now invested in the iron and steel industry, the published balance sheets of steel companies representing over 85 per cent. of the country's ingot capacity show a capitalisation of approximately 4½ billion dollars. According to these reports, earnings for the years 1925 and 1926 are respectively 5·61 and 6·70 per cent. on the capital invested. It thus appears that while the wage-earner, the consumer, and the public in general have been very distinctly benefited, capital has not fared so well.

Increase in Steel Capacity.—Due to the exigencies and stimulation of the war, the ingot capacity of the United States increased slightly over 15 million tons for the six years 1915 to 1920 inclusive, or at the rate of approximately 2½ million tons per year.

The end of the war left the country with excess plant development, and for six years subsequent to 1920 the total ingot capacity increased less than 3½ million tons, or at the approximate rate of half a million tons per year. The theoretical steel ingot capacity of the nation is to-day, in round numbers, 58 million tons. While during the war no expense was spared to enlarge the country's steel capacity, investment during the last six years has been made with special reference to the reduction of costs, diversification of product, and the betterment of quality instead of increased production.

This explains why the installation of power and labour-saving machinery has been of late so strongly emphasised, and why there has been such heavy scrapping of inefficient and obsolete machinery and plant. Irrespective of its physical condition or its length of service, it is not good business to continue to use machinery if a better design will pay a fair return on its investment by reducing costs. The American practice is drastic in this regard, and it is only by such a progressive policy that any concern or any nation can hope to keep abreast of the times and successfully maintain its position.

But given the vision and courage to adopt such a policy, whence comes the capital with which to finance such undertakings? It may be trite to recall that capital, practically speaking, is but earnings saved, but it is perhaps not so obvious that the amount of saving largely depends upon the surplus output of the individual. Because this surplus has been gradually expanding for many years through reproductive effort and reproductive investment, not only has wealth grown but its distribution is wider than ever before.

The nation's savings deposits of over 24½ billion dollars, with its 46¾ million depositors, is an index of the extent to which capital has been distributed, and the long lists of small stockholders in industrial corporations illustrate the rapidly growing character of its investment. The aggregate wealth of the United States no longer lies in the excessively rich, but in the small property owner whose name is legion, and more and more does management represent and stand between him and concentrated ownership.

Management.—Just as the exigencies of expanding business fifty years ago resulted in the small corporation taking the place of individual ownership and control, so their resulting economies brought into existence the larger corporations of to-day. In the last two decades of the nineteenth century there was not always a proper appreciation of the difference in power and responsibility between large and small aggregations of capital. Management was then apt to measure responsibility and success by the profits it made rather than by the methods it employed. The rights of the public, the competitor, and employee were oft-times neglected; monopoly was not always discountenanced; labour was sometimes exploited; prices were apt to fluctuate from exorbitant heights in good times to ruinously low figures in bad times; competition was frequently destructive, and business ethics too often failed to square with the golden rule.

Such principles and methods of doing business fell into disrepute years ago. Management learned that the difference between monopoly and unreasoning competition is the difference between ephemeral success to the few and industrial suicide by the many, that the exorbitant profits of a peak demand were offset by the losses of succeeding reaction, and that stability in price helps stability in operation.

To-day modern management stands not as the representative of capital alone, but as an entity representing the interests of the public, the stockholder, and the employee. For the development of this sense of plural trusteeship and the creation of the new spirit of co-operation that now animates all well-managed American concerns, the management of the United States Steel Corporation is in no small measure responsible.

The United States Steel Corporation commenced business on April 1st, 1901, with a capital structure of nearly 1½ billion dollars. It represented a merger of ten large companies, each prominent in its own field. It was a consolidation of consolidations, most daring in its conception and destined to be monumental in its achievement. Its initial capacity in steel ingots and castings was 9½ million tons, which comprised 65 per cent. of the country's total output. To-day it represents but 45 per cent. of the nation's tonnage with its production of 23 million tons.

At the time of its organisation the failure of the enterprise was freely prophesied because of its colossal size. The public was suspicious of its monopolistic potentiality. Organised labour dreaded its power, and rivals feared possible unfair competition. During its existence it has twice been seriously attacked by organised labour, and for years it was in the courts because of the Government suit brought for its dissolution.

In spite of dire prophecy and unjust attack the corporation, after more than a quarter of a century of constructive effort, not only stands to-day absolved by the Government and the people of unfair practice, but is recognised throughout industry as an exemplar of efficiency and high business standards.

Since the beginning of the United States Steel Corporation Judge E. H. Gary has guided its policies. To him is largely due that publicity in corporate affairs which principally found its birth in the innovation of regular and detailed statements of the Corporation's activities. To the public the Corporation's policy has meant reasonable prices and knowledge of the Corporation's results; to its competitors, co-operation and a stabilising influence; to its employees a more generous return than ever before paid by the industry; and to its stockholders a fair return on their investment.

In management as in other departments of American industry the job seeks the man, and character and ability

are the determining factors. Perhaps nowhere is the success of this dominant policy more strikingly illustrated than in the leaders of America's two largest corporations in the steel industry. The character and accomplishment of Elbert H. Gary and James A. Farrell, of the United States Steel Corporation, and Charles M. Schwab and Eugene G. Grace, of the Bethlehem Steel Company, chief executives and presidents respectively of their corporations, need no elaboration here. Their prestige and resource is distinctly an heritage of ability and hard work, and their history symbolises to a marked degree American opportunity and American accomplishment.

Labour.—Because of the large increase in the number of small investors the line of demarcation between so-called labour and capital is rapidly lessening. There is a better appreciation to-day that the nation's capital is principally the savings of labour's thrift and is largely owned by labour itself. With the dissemination of this truth has also gone a better realisation that in American industry the labour of the office and the counting-room is in the same economic category as the labour of the mill or field, and that the officials of management are just as truly employees of the corporation which hires them as the men working under their direction.

The composite American workman is of a high order of intelligence, peculiarly free from traditional bias and restraint, and welcomes as a rule mechanical assistance for the increasing of his output because of its greater attendant earnings. He is especially jealous of his right to freedom of action, is quick to resent unjust treatment, and does not hesitate to change the character or place of his employment if dissatisfied or if better opportunity presents. He resents political and organised domination, and prefers his own negotiations to bargaining by representatives.

That these statements reasonably reflect the general character of the largely predominating mass of skilled and unskilled labour in the United States to-day is demonstrated by the fact that attempted political dictation by organised labour even in their own ranks has been a failure, and that the United States is essentially an open-shop country. Of the 117,000,000 of its inhabitants about 44,000,000 are "gainfully" employed, and of these about 8,500,000 are found in the manufacturing industry. Organised labour has in its enrolment something less than 4,000,000 workers, and these are principally found in the mining, transport, building, and textile industries.

Formerly when short-sighted management ofttimes led to the oppression of the worker, and when co-operation between employer and employee was more stressed by its breach than by its observance, organisation of labour grew rapidly, because of its protective appeal to the individual. To-day, however, a better understanding of common aims and a clearer knowledge that even armed neutrality is unprofitable, has resulted in an appreciable lessening of interest on the part of the worker in labour organisations, as is indicated by a reduction in the membership of the American Federation of Labour from 4,078,740 in 1920 to 2,803,966 in 1926.

The iron and steel industry of the United States is operated on an open-shop basis. Employment is not concerned with nationality, politics, religion, or union affiliation; and plant representation, negotiation as to wages, and methods of work are distinctly between the management and the men, singly or collectively, and not through outside agents.

An exception to this general rule is found in a few small mills where the Amalgamated Association of Iron and Steel Workers is still recognised. That their influence is small is indicated by the fact that while the iron and steel industry employs about 400,000 men, the Amalgamated Association's enrolment has fallen from a membership of 14,035 in 1900 to 11,174 in 1926.

Some of the American labour unions have maintained their position through conservative leadership and the rejection of radicalism. More, however, have lost ground by attempting militantly to force domination on peaceful industry and by insisting on wages, hours, and rules that were unfair to the public because out of harmony with economic principles and existing conditions.

It is one thing for labour or for management to use its might to right a wrong. It is another thing to disrupt a community or a nation for selfish aggrandisement, and American public opinion has thus far refused to sanction special privilege to either labour, management or capital.

As a result of this attitude both management and labour have found that fair dealing is remunerative as well as ethical, and that co-operation is more productive than oppression. That there has been of late years much better co-operation on the part of the vast majority of the labour body is by no means solely due to the higher wages that they have received. Management early in the century began more practically to recognise their obligations to the human side of industry. It found that the minimisation of occupational hazard, sanitary surroundings, hospitals, better housing, and other welfare work which promoted the health and happiness of the worker and his family was not only humane, but paid by the goodwill and the co-operative spirit that it inculcated. In the development and application of this new science of human engineering the iron and steel industry, inspired by the example of the United States Steel Corporation, has taken a most prominent part.

In 1906 the United States Steel Corporation inaugurated a campaign of safety, sanitation and welfare, which has ever since been vigorously pursued. Tonnage and costs became no longer the *sine quâ non* of achievement, and the safety and welfare of the worker is a vital consideration in mill operations.

Accident prevention has naturally been most prominently stressed. The safeguarding of machinery starts with the draughting board in all construction, and is diligently pursued thereafter as experience permits. Education and organisation of men into safety committees plays an important part, and that expense is not allowed to interfere with the desired object is indicated by the expenditure by the United States Steel Corporation last year of 1¾ million dollars in safety work.

As a result of such intensified effort extraordinary reduction in the accident rate has been achieved. Among the quarter of a million men employed by the United States Steel Corporation in 1926 the rate of disabling accidents was 3·26 per cent., as compared with 20·57 per cent. in 1912, or a reduction of 84·15 per cent. of the former rate. That means that in the company 365,277 men have been saved from disabling injuries since 1912, as measured by the sum of the reduction in accidents each year.

In addition to the payment of liberal wages various corporations seek to improve the financial condition of their employees by affording them the privilege of stock subscription on advantageous terms. In the United States Steel Corporation, in illustration, there were 47,647 employees registered as stockholders as on December 31st, 1925, who held 665,801 shares of the Corporation's preferred and common stock, with an aggregate value of over 100 million dollars. Like the Corporation's safety and other welfare activities, this method of encouraging a partnership relation is absolutely divorced from any paternalistic method or condition, to which both men and management rightfully object.

Consumption and Markets.—At the beginning of the century the United States, with a population of 76,000,000 people, produced 9½ million tons of finished steel, while in 1926, with a population of 117,000,000, this output had risen to 35½ million tons. In other words, each inhabitant as an average used 739 lb. of finished steel in 1926, as compared with 279 lb. in 1900, or over two and a-half times more now than formerly. This expansion is essentially due to increased domestic demand, and has been but little influenced by the small percentage of growth in the country's foreign trade. The following statistics show how small this change has been. The iron and steel imports and exports of the United States, in round numbers, were respectively 200,000 tons and 1,000,000 tons in 1900, as compared with imports of 1,000,000 tons and exports of 2,000,000 tons in 1926.

The increasing ramifications of steel's new uses are continually making for widening markets. With greater diversification of product has come an insistent demand for quality, so that to-day trade requirements are infinitely more severe than in former years. The comparatively rapid growth of alloy steels and the increasing call for electrical refining is a result of this demand, and such special steels are an important and growing factor in the economic progress of the country. The change in the character of the demand is illustrated by the item of rails. At the beginning of the century the production of rails absorbed 25 per cent. of the country's entire steel output. Last year, although the rail tonnage was half again as large as it was twenty-five years ago, it represented only 9 per cent. of the country's steel production.

In the new demand for steel the most important development is the expansion of the automotive industry, which last year took 15 per cent. of the nation's output.

In the development of this industry the accomplishment of Henry Ford is outstanding. To his genius, courage and vision we must pay high tribute when analysing the effect of high production and the increased *per capita* production that has followed his methods. To his doors has come the world to study the specialisation of men and machines, and his practice and high wages have been made prosperity's text by various international expounders of economic and social conditions. But while industry owes much to Mr. Ford, his methods and his results may easily lead to false conclusions if superficially studied. Thanks to his foresight and inventive genius, he produced a car which in its sturdiness and its low price so far outclassed his competitors as to amount temporarily to a monopoly. With an almost insatiable public demand, his profits, though legitimately made, were so large as to put his enterprise outside the pale of ordinary competitive conditions.

It is as a monopoly, not as a competitive industry, that Mr. Ford's past achievement must be studied if proper deductions are to be drawn. The present intensive competition by powerful interests, in low-priced models, promises to emphasise this fact.

Between the manufacturers of steel in the United States there is free exchange of ideas and information in respect to equipment and practice, and former secrecy has given way to a courteous welcome to both foreign and domestic competitors. In the matter of sales, however, while information concerning prices may be legally exchanged, anything in the way of price agreement or restraint of trade is outside the law. Although industrial combination carries with it the possibility of service to the community by saving in operation and saving in distribution it may also carry with it the possibility of unreasonable prices. That the public in the United States feared the possible monopolistic power of the industrial merger more than it appreciated its constructive force is evidenced by the Sherman anti-trust law and the subsequent anti-trust legislation that has been enacted. The difference between governmental encouragement of the cartel in Europe, and the discouragement of industrial combinations in the United States is therefore a difference in the public state of mind. That the United States laws against trade agreement and in favour of unrestricted competition are economically sound is subject to grave question. That uncontrolled licence to combine would be in the long run more economically sound is likewise open to doubt. Possibly a happy medium could be found in permissive regulation. In any event, President Coolidge's dictum of more business in government and less government in business rings true in the light of general experience.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RECENT BRITISH LOCOMOTIVES.

Sir,—I have read with pleasure Mr. C. M. Keiller's letter in your issue dated October 7th.

As a practical locomotive engineer I am, of course, fully alive to the fact that the total economy of a locomotive is not bound up solely in fuel consumption. At the same time, it must on all hands be admitted that the enormous increase which has taken place in the railway companies' expenditure in consequence of the rise in coal prices is so serious as to justify further experiments with compounding. For I am convinced that this feature, which I have proved for myself can be made to give good results, would effect considerable economy, either directly or indirectly, according to whether an augmentation in power were chiefly aimed at, or a given power on a smaller consumption of fuel. In either case, owing to the smaller quantity of steam used, following the adoption of an early cut-off, there would be a saving amply sufficient to make compounding worth while at the present time. As explained by me in the above mentioned issue, however, I am not in favour of the three-cylinder system in which one high-pressure cylinder is used. Instead, I prefer and recommend the "treble" plan, with one large low-pressure cylinder and two outside high-pressure cylinders. The three cranks to be set at 120 deg. apart, and, needless to say, the two or more pairs of driving wheels to be coupled together. If Mr. Webb had but employed coupling-rods and retained the high-pressure cylinder of a simple engine on his three-cylinder passenger engines, it might well be that the story of locomotive compounding in this country would have been very different from what it is to-day. This fact is mentioned because there is now little doubt that the non-coupling of the two pairs of driving wheels spoilt an otherwise good design, and incidentally helped to bring discredit on the engines and also, to some extent, on British compounding in general. The engines did good work, but the feature in question caused them at times to be unreliable.

Apart from the fault—rectified to-day—the Webb triple-cylinder system is the one which, of all others, is best capable of providing a maximum of cylinder dimensions, and therefore of power in a British locomotive of orthodox design. From the economic standpoint it is essential that all three cylinders should be of the largest diameter permissible. First, because the high-pressure cylinders should be of such a size as will enable the engine to start the heaviest load with ease by means of these cylinders alone; and secondly, because the bigger the high-pressure cylinders the shorter can be the cut-off, and the greater can be the range of expansion. Hence my suggestion is for a compound express locomotive with a pair of 20in. high-pressure cylinders and one 42in. low-pressure cylinder, the latter occupying nearly the full width of 4ft. 1½in. between the main frames. The low-pressure piston could be V-shaped of stamped steel. The longest high-pressure cut-off for running purposes I would recommend be fixed at 25 per cent., the reversing sector being arranged for full forward and backward gear, and with a limited number of notches towards the centre, allowing for a working cut-off not exceeding the before-mentioned amount. For the low-pressure cylinder it might be advisable or necessary to have two steam chests, one on either side on top, and the valve or valves of this cylinder would invariably be operated in full gear through the medium of loose excentrics, as the case may be.

Assuming the engine to have two 20in. high-pressure cylinders and a 42in. low-pressure cylinder, it would develop greater power than the Baldwin compound No. 60,000. The latter is the equivalent of an engine having two cylinders 27in. in diameter, whereas my projected locomotive would represent a simple having a pair of two 29½in. cylinders, or, again, a four-cylinder non-compound with 20½in. cylinders.

It is quite obvious that logically the boiler which could easily and freely supply steam for a couple of 20in. cylinders, viz., the high-pressure pair of the compound, could not, other things being equal, furnish sufficient steam for the simple engine having either two 29½in. cylinders or four 20½in. diameter. This fact alone serves to demonstrate the advantages of compounding especially as power for power the lower steam rate means a corresponding reduction in coal consumption.

With regard to the point raised by Mr. Keiller as to the compression being excessive with very early cut-off, I may say that I devised an improved form of Walschaerts valve-gear with the object of overcoming this very drawback. When cutting off at 25 per cent. this gear gives a release of 88 per cent., and it can, moreover, be employed for operating any kind of poppet valve. With my proposed system, the back pressure is necessarily very moderate, as the receiver pressure need never exceed 25 lb. per square inch.; this pressure too is fairly constant, owing to the fact that the two exhausts from the high-pressure cylinders take place during the one forward or backward stroke of the low-pressure piston.

By comparison with those of some systems the cylinder ratios are low, but as the engine is designed for a maximum cut-off of 25 per cent. in the high-pressure cylinders when at work, the ratio of the compound in question (having two 20in. high-pressure and one 42in. low-pressure cylinder) may be considered to be virtually as 1 : 9, a proportion that is in excess of that adopted in modern compound practice.

The use of high-pressure cylinders of large diameter has the important advantage of increasing the number of expansions beyond the number possible in the case of comparatively small such cylinders, in which the employment of a late cut-off is unavoidable. Only in the way mentioned can the potential power in the steam be fully utilised, and the higher the boiler pressure the better should be the results. At any rate, it seems to me that the time has arrived when a triple-cylinder compound, on the lines suggested herein, and having a working pressure of 250 lb. per square inch, should be built and tested. It would go far to settle the controversy of compound *versus* simple locomotives, and would, I have no doubt, prove to be a success, provided that all the details are carefully worked out.

John Riekie.

Brockley, October 10th.

Sir,—Your correspondent, Mr. King, repeats at length what we all know, that compounding gives an increase of thermal efficiency over single stage expansion, though I think few will agree with his 50 per cent. to 60 per cent. increase; but the point at issue is, as I have suggested previously, that the compound suffers from the serious disability of a low maximum tractive effort as compared with a like size simple engine.

Mr. King does nothing to disprove this; he has certainly asserted that the total M.E.P. referred to the H.P. cylinder reaches the figure of 143 per cent. of the boiler pressure; but as this pressure seems to be higher than theoretically possible, and does not seem to be approached in practice, he cannot expect us to accept it without adequate proof, all the more so as this gentleman's figures and statements seem to be at variance with other authorities, as note he states that in Italy the superheated simples used up to 10 per cent. more coal than the saturated compounds, and had considerably less capacity to pick up lost time; yet by the side of this we have a letter from an Italian engineer stating definitely that the opposite was the case.

Mr. King's example of the result of the Swedish locomotive running both simple and compound is thoroughly misleading, and it is difficult to understand why he quotes it; equally inexplicable is his contempt for the "semi-simple" de Glehn compounds; after all these despised machines have and still put up on the French Nord the most brilliant locomotive work in the world, without exception.

Mr. King also asserts that the most efficient way of driving

a simple engine is with throttled regulator and long cut-offs, and in his usual manner indicates what he thinks of the British locomotive world in general for not adopting this method. Mr. King seems strangely out of touch with things; surely he must know that of recent times, with the exception of the G.W.R., this is the very method that has been in general use in this country. Within the last few years, however, there has been a general move to follow the G.W.R. lead of providing locomotives that can be driven on full regulator and short cut-offs, and in instructing the crews to so handle them. I do not think there can be much question that the results in all cases have shown better performance with greater economy; for example, compare the work of the S.R. "King Arthurs" with that of the machines in their original form.

With railway locomotives I do not think it at all follows that the one that shows the lowest coal per I.H.P. hour is going to use the smallest amount of coal in actual train running; the history of the locomotive is full of the most unexpected results, both in performance and economy. In connection with local conditions governing design it is worth noting that continental coal is generally soft and dusty, it does not require a strong blast to burn it, and any attempt at forcing simply blows it out of the chimney; on the other hand, coal in this country is hard, and not only requires more draught in the ordinary way, but will stand a lot of forcing, with the result that under certain conditions the simple engine can obtain vastly greater evaporation from a given boiler than can a compound.

We are much indebted to Mr. Pecori, whose letter confirms what one might term the general opinion on this matter. I should be extremely obliged if Mr. Pecori would give us the coal consumption, both per train mile and per I.H.P. hour for the superheated compounds and simples on the same work.

C. M. Keiller.

Berks, October 15th.

THE LOCOMOTIVE INDUSTRY.

Sir,—The article on "The Locomotive Industry," by a correspondent in your issue of the 7th inst., commenting on Mr. Gresley's presidential address to the Institution of Locomotive Engineers offers rather unfair criticism of the railway companies with regard to locomotive engineering.

It is open to very great question whether "their knowledge must be everybody's," as the correspondent asserts; and the idea of a national testing plant or its value is hardly dependent on his assertion.

The information obtained by the C.M.E. of a railway company from the test runs of a locomotive is not only the measure of its capabilities, but also the data from which he is able to produce further improvements in future engines, and he is under no obligation to publish it.

Hundreds of British engines have been built in the past without reference to American or German data, to which the correspondent credits "the general knowledge of this important subject."

It is to be hoped that the idea of a national testing plant for locomotives will mature, and perhaps it could be accomplished by gratuitous subscriptions from home railways, colonial and other foreign railways who generally have their engines built here, and also our private builders of locomotives.

Apart from the fine opportunity of scientific research the plant would provide, the test results of engines destined for abroad would be of great value to those chief mechanical engineers who have not the facilities for service tests of their engines.

October 17th. M. I. Mech. E.

Sir,—Those who are interested, on practical or sentimental grounds, in the future of that true-born Englishman, the steam locomotive, should be grateful to Mr. Gresley for his recent address.

To me, as an onlooker, it seems to be a milestone towards that better understanding and co-operation between the home railways and the locomotive builders which is highly desirable in the interests of both and of the trade of the country generally.

These two particular industries should again become, as they once were, complementary.

Having in view the ever widening gulf between them, as the railways have more and more become manufacturers, one can realise that Mr. Gresley's public expression of sympathy with the locomotive builders was as generous as it was unique.

In other respects it was equally courageous.

J. G. H. Warren.

Bath, October 16th.

MECHANISATION OF THE ARMY.

Sir,—Quite apart from the increased cost, misgivings have been aroused from a military organisation and administrative point of view, which I do not propose to touch on, as these views have been ably expressed by competent military authorities in correspondence in the daily Press. The full import, however, to mechanical and automobile engineers does not seem to be fully recognised.

The scheme as at present outlined violates all known principles of engineering efficiency. In the same Command we shall have two sets of workshops, two sets of *personnel*, duplication of spare parts and stores and *personnel* to handle them.

Visualise for a moment a civil manufacturing establishment endeavouring to handle a given output of one pattern, and it being seriously proposed to manufacture and handle, say, 40 per cent. of this output in one establishment and the balance of 60 per cent. in another establishment perhaps three streets away. This, in effect, is the type of "economy" which reorganisation under this scheme will lead us to.

Further, in placing the control of research, experiment, design, manufacture, inspection, provision, storage, issue and repair of mechanised vehicles of all types in the hands of the Master-General of Ordnance and the officers of his Department (who are mostly artillery officers with highly specialised training) is to ignore the experience gained during the late war.

In the winter of 1914, when the war was in full swing, it is well known that a breakdown occurred in carrying out the heavy repairs and maintenance of M.T. vehicles by the Ordnance workshops, and these duties were then transferred to the R.A.S.C. and successfully carried out by them in all theatres of war.

Further, the proposed procedure runs counter to commercial experience, dearly bought, during the last twenty years by armament firms in civil life.

It is well recognised now by such firms that automobile engineering is a separate and distinct branch of mechanical engineering. Those who in the past have tried to combine automobile with other branches of engineering in the same establishment have since abandoned this costly experiment, and there is not a single firm to-day which does not keep its automobile engineering organisation distinct and apart from any other branch and with a separate *personnel*. Armstrongs, B.S.A., the Coventry Ordnance Company, Enfield, to mention a few only at home; De Dietrich and Creusot in France; Krupp and Lloyd in Germany; F.N. in Belgium, are but a few who tried to combine both branches. They failed until their automobile branches were organised as separate establishments.

Whilst this proposed scheme will work extravagantly and inefficiently in peace time, it could not stand the searching test of wartime conditions.

In a leading article *The Times* of September 19th advocates that "A decision so far-reaching in its effects might have been deferred until, as in the case of the last great reorganisation, evidence from all arms, departments and civil industries concerned had been heard and sifted by a committee presided over by an impartial chairman." With such a proposal all who desire efficiency combined with economy must agree.

London, October 18th. E. A. Rose, Lt.-Col.

BRITISH HELP TO FOREIGN ENGINEERS.

Sir,—The Irish Free State want to borrow 2½ millions for their Shannon electrification scheme, and are asking the British Government to guarantee the loan. As they gave the contract for the work to Germans, and not to Englishmen, they are not entitled to such help, and our Government has no right to give it.

If it refuses, then the Free State cannot and will not impute any unfairness or unfriendliness, but will see that the refusal is only just and business-like, and will realise the advantage of employing British firms and engineers in the future.

October 11th. Fair Play.

BRITISH AND FOREIGN STEEL.

Sir,—In your issue of September 9th, you published a remarkable article from Mr. J. W. Hall in support of the British steelmakers' deferred rebate scheme, which has since been republished in pamphlet form by the British steelmakers. I ask leave to comment on this article, as briefly as I can.

Generally speaking, Mr. Hall's survey of the steel industry impresses me as both interesting and correct. But I differ from him altogether in his attitude towards the deferred rebate scheme and in his technical description of the Bessemer basic process as at present practised.

He begins by calling the deferred rebate a "Bounty scheme," and later a "bonus." I have elsewhere (*Times*, September 5th) given reasons for regarding it rather as "a scheme of price-maintenance at the expense of the consuming industries," and one which will prove injurious to steelmaker and consumer alike. It is, at least, obvious that the essential feature of the scheme is an attempt to coerce the British steel user into using British steel exclusively.

Now, I venture to say that the correct attitude for an engineer is first one of scientific detachment, free from all national and political prejudices. And secondly, that he should primarily regard the interests, not of the British manufacturer, but of the steel user by whom he is appointed. From this point of view, Mr. Hall should surely have adopted a more critical attitude towards a proposal of which the avowed object is to restrict the user's sources of supply.

To turn now to Mr. Hall's technical argument:

It is no longer true that "steel for constructional purposes purchased on the Continent is practically all basic Bessemer steel." On the contrary, in Germany, the open-hearth process is rapidly supplanting the Bessemer basic process; and this for an economic reason of precisely the same order as that which has destroyed it in England, namely, lack of suitable ores. Moreover, the steel used in shipbuilding is exclusively open-hearth steel, and it is chiefly in this branch of the trade that the exceptional importation has occurred which gave rise to the rebate scheme.

Mr. Hall's description of the Bessemer basic process is extraordinarily inaccurate. He states more than once that (in order to obtain the requisite heat) the pig iron used must contain 3 per cent. of phosphorus. In point of fact, the Bessemer basic steel works in Luxembourg, Belgium and Lorraine are all working on a pig containing from 1·8 to 2 per cent. P., and the same remark applies to most of the Bessemer basic steel works in Germany. Again, he states that if the finished steel is to contain not more than 0·07 per cent. P., the blown metal, before adding the "finals," must contain not more than 0·03 per cent. P. This is equally incorrect. The writer has before him a series of chemical analyses of steel made at the Differdange Works, the analyses being taken before and after the final addition of ferro-manganese; these show an average increase of phosphorus, not from ·03 to ·07, but from ·053 to ·062 per cent. only.

It is evident from these and other similar errors that Mr. Hall is unfamiliar with modern continental practice. Metallurgy has made enormous strides in recent years, and it is really preposterous to cite in evidence Mr. Hall's experience of it in 1890.

I believe the truth of the matter to be this: Our native ores are unsuitable for the Bessemer basic process, and it has never been practised successfully in this country. But the Minette ore of Luxembourg and Lorraine is ideally suited to it; and mild steel of the highest quality can be and, at some works, is made by the Bessemer basic process. But it does not lend itself so readily as the open-hearth process to the manufacture of a variety of grades of steel; it is essentially a mass production process. Mr. Hall considers it an extremely difficult process, and it certainly requires both care and experience. But in a modern continental steel works, working on ores of uniform character and where the converters draw on a mixer containing a 10 hours' supply of uniform metal, the process is almost automatic.

I agree that, in general, a better and more reliable steel is, in fact, produced in Great Britain than on the Continent, but this is no more attributable to the process than is the difference in quality between Staffordshire and common Belgian iron. The most that can be said is that it is easier to turn out bad steel by the Bessemer basic process, if the manufacturer is indifferent or unscrupulous. But there are good and bad manufacturers in all countries. And to suggest that the Bessemer basic steel is necessarily bad is really childish in view of the fact that the rails, bridges and carriage underframes on the continental railways are made almost exclusively of Bessemer basic steel.

Mr. Hall tells us that, with rare exceptions, "For thirty years past (he) has resolutely refused to accept basic Bessemer steel, wherever made." My experience of it does not date back so far, but it is perhaps more relevant. During the past twenty-five years I have been concerned with the disposal of at least 250,000 tons of steel beams made from Bessemer steel and under conditions which would certainly cause me to hear of any serious complaint. The beams in question have been used in every type of construction, including railway bridges, coaling staiths and other structures subject to repeated shock. Yet I can only recall a single incident reflecting on the quality of the steel, and not a single failure in actual use. Could any open-hearth manufacturer say as much? R. A. Skelton.

Moorfields, London, E.C. 2, October 12th.

Sir,—I thank you for giving me an opportunity of replying to Mr. Skelton's letter of the 12th inst., concerning my article in your issue of September 9th last.

Mr. Skelton says: "It is easier to turn out bad steel by the basic Bessemer process," "It is essentially a mass production process," "It certainly requires both care and experience," "Our native ores are unsuitable for the Bessemer basic process," "But the Minette ore of Luxemburg and Lorraine is ideally suited to it," "It does not lend itself so readily as the open-hearth process to the manufacture of a variety of grades of steel."

All this is what I said, and I notice, in your last week's issue, that the British Engineering Standards Association are removing the basic Bessemer process from certain standard specifications for rails, from which we may conclude that B.E.S.A. are in agreement with Mr. Skelton and myself as to its unsuitability for making high-carbon steels.

The difference on other technical points between Mr. Skelton and myself appears to be one of degree only. Minette ore, as Mr. Skelton says, gives a pig with only 2 per cent. P and the Germans used to import phosphoric material to make up the difference, and I believe still do so. I am prepared to accept Mr. Skelton's statement that the works he mentions are now in some way managing with 2 per cent. P, but shortening the after-blow narrows the margin of time for error, and does not help matters. I cannot think Mr. Skelton intends to imply that 0·062 P is generally found in basic Bessemer steel to-day; the figures I get are 0·07 to 0·1 and sometimes over 0·1. My experience is not confined to 1890, but the defects of basic Bessemer steel have been particularly forced on my notice during the past six months.

Mr. Skelton says: "Now I venture to say that the correct attitude for an engineer is first one of scientific detachment, free from all national and political prejudices. And secondly, that he should primarily regard the interests, not of the British manufacturer, but of the steel user by whom he is appointed." It was a large user, having no real appreciation of the essential differences between basic Bessemer and basic open-hearth steel, who urged me, some months ago, to write an article explaining it. I dismissed the matter, but finding the difference was not generally appreciated by users, I decided to write, and no one was more surprised than I was to hear that Messrs. Peat were sending out a reprint of my article on behalf of some association of steel makers.

My object in writing was to make clear to users what were the facts, and why "I had resolutely refused to accept basic Bessemer steel *wherever made*." Any national or political prejudice has not been introduced by me, but as Mr. Skelton has said, "in general, a better and more reliable steel is in fact produced in Great Britain than on the Continent," I may perhaps be permitted to say that I agree with him.

Birmingham, October 18th. John W. Hall.

GERMAN EXHIBITS AT THE MACHINE TOOL EXHIBITION.

Sir,—Your correspondents' remarks upon the exclusion of German exhibits from the forthcoming Machine Tool Exhibition prompt me to register a protest having direct bearing upon this matter.

Why was the recent Engineering Exhibition so oppressively foreign? One made a careful tour of the main floor and became more and more astonished at the number of foreign exhibits, and later found this presumably due to an embargo by the Machine Tool Trades Association, whose members were exhibiting later on.

As one who strives to remain "British Throughout," I still think the interests of the British engineering industry are best served by leaving such Exhibitions open to all nationalities, and that British machine tool makers should have sent their full quota to Olympia recently. Frank Hills.

Goodmayes, Essex, October 18th.

Recent ore hoist installations in the Butte copper mines incorporate in their design two important departures from established practice which promise greater economy and safer operation. In two recently completed installations the conventional induction motor generator fly-wheel set has given way to a synchronous motor-driven generator for supplying the direct-current hoist motor. The advantages of the synchronous motor generator set over the induction motor fly-wheel set, particularly its power factor correcting capability and smaller consumption of energy, are so great that it seems probable that future hoisting equipment design will tend strongly towards synchronous motor drive for the direct-current generator. A second feature of these new hoists is the application of dynamic braking to the main direct-current hoist motor.

The new transmission line of the Shawinigan Water and Power Company, which links the Duke-Price hydro-electric development at Isle Malignes, on the Saguenay River, with the lines of the Quebec Power Company has been completed, and is now delivering power in the territory surrounding the city of Quebec. The new power line, upwards of 100 miles in length, traverses the Laurentides Park, and makes available 100,000 horse-power for the industrial activities which are taking place in the Quebec City neighbourhood. A considerable portion of the power contracted for by the Shawinigan company from the Duke-Price Power Company will be used in pulp and paper manufacturing. Through the lines of the Quebec Power Company, a subsidiary of the Shawinigan concern, the new plant of the St. Anne Paper Company at Beaupre, is already receiving power from the Saguenay, and when the Anglo-Canadian Pulp and Paper Mills, now under construction, begin production, its machines will be operated by power from the same source.

Motor Car Show at Olympia.

No. II. (*Conclusion*).*

Although some of the sensational reports which have recently made their annual appearance in a certain section of the Press with regard to the orders which have been placed for cars at Olympia should not be accepted without reserve, a visit to the Show cannot fail to impress visitors with the remarkable prosperity of the motor car industry. With one and three-quarter million cars already in use in Britain, and most of the principal roads loaded with traffic to "saturation" point, the chief anxiety of our rulers will shortly be concerned with providing still more and wider roads to cope with the motor problem.

Observant visitors to the Show will also note how successfully British car manufacturers are competing with the other nations, in respect both of originality and value. Only a very few years ago France had the reputation of leading in quality, just as the United States, with its huge home markets, led in the matter of price. Both of these claims have now to be modified. The requirements of those who can afford the more expensive cars are as well catered for by British makers as are those of the constantly widening circle of buyers who come within the category of "average means," for whom the temptations of the "instalment system" are daily becoming more difficult to resist.

We dealt last week with a few of the new cars which are on view, and made special mention of the number of six-cylinder vehicles which form part of the makers' programmes for next year, but we omitted to mention that the eight-cylinder engine is also being built by quite a number of makers, while the Daimler Company will continue to produce its masterpiece in the shape of a twelve-cylinder engine. The first British eight-cylinder car to be put on the market at a competitive price is that of the Wolseley firm. With a fabric body this machine will be sold at a figure which would have appeared fantastic three or four years ago. We deal with it later in this article. The other names of eight-cylinder cars are Mormon and Auburn from America, Ballot and Bugatti from France, and Horch from Germany.

Last week we referred also to some of the developments which have taken place in connection with ignition systems. The British Thomson-Houston Company has an exhibit of particular interest in this connection, namely, a combined magneto-coil ignition system which is applicable to four, six and even eight-cylinder cars. In these sets, a magneto of the polar inductor type with automatic ignition timing device, has high and low-tension terminals to permit of the contact breaker and distributor being used in conjunction with a separate ignition coil. By means of a high and low-tension change-over switch, controlled from the dashboard, the driver can change quickly from one system to the other. As the same distributor head and drive are used for both magneto and coil, the initial expense and cost of installation are reduced to a minimum, while the wiring is quite simple. The automatic timing device being mounted on the magneto spindle, the engine timing is varied according to its speed without affecting the quality of the spark from the magneto, and the best conditions are obtained for starting and slow running. A wide timing range is available, the automatic device providing a 30 deg. range on the magneto spindle, whilst the contact breaker base may be fixed or arranged to provide 15 deg. or 22 deg. on the manual control, according to the requirements, thus making a possible total movement of 52 deg. on the magneto. While on the subject of magnetos, mention should also be made of the flexible coupling of novel construction shown by the same company, in which the driven member is a sliding fit in the driving member to allow the magneto to be withdrawn and reinstated with ease and without adjustment. The driven member is of octagonal form and the driving member comprises an outer sleeve and an inner ring provided with four flat-leaf springs. The driven member is held on four faces by the springs, and any necessary adjustment for advance or retard of the spark is made by relative movement between the inner ring and outer sleeve of the driving part. The whole can be locked in a very simple manner. This device is a great improvement on some with which we have had experience.

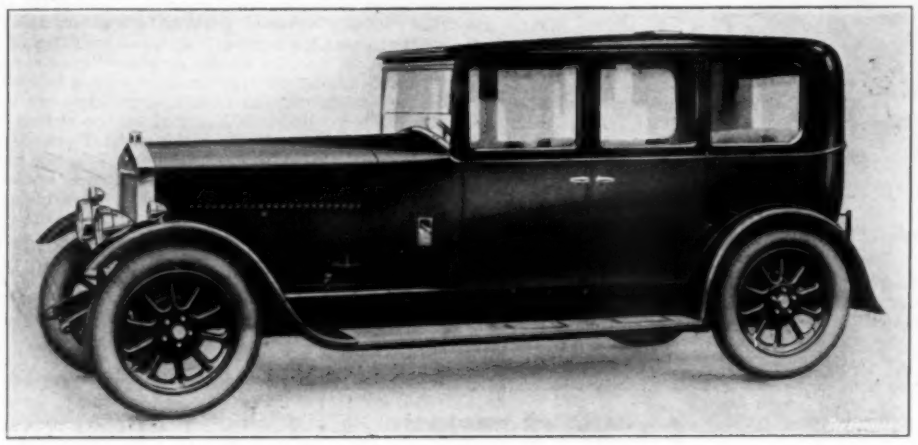


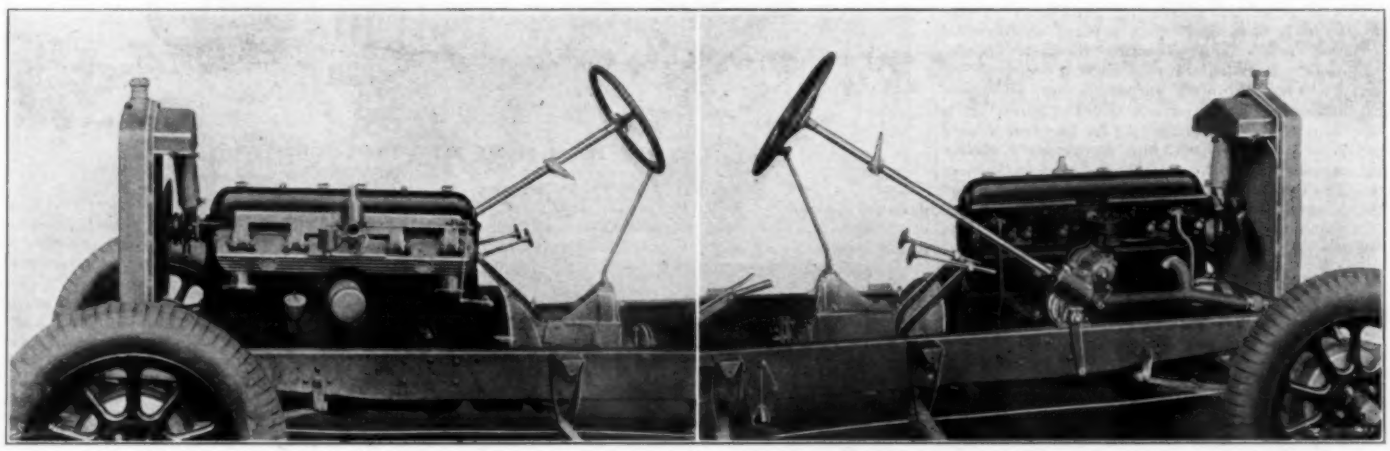
FIG. 15—21-60 H.P. WOLSELEY 8-CYLINDER SALOON

17·7 Horse-power Morris Car.

One of the greatest attractions in the Show is the new six-cylinder car of Morris Motors, Ltd. This car has cylinders 69 mm. bore by 110 mm. stroke, and a Treasury rating of 17·7 horse-power. The engine has overhead valves and cam shaft, pressure lubrication, magneto ignition and automatic S.U. carburetter. Transmission is by a single plate clutch, three-speed unit gear-box, enclosed propeller shaft and spiral bevel final drive. Brakes are fitted on all four wheels, and the chassis is provided with oil gun lubrication. The engine is a very clean-looking job, the cam shaft running centrally along the top and carried in four bearings. Over this shaft is a hollow rocker shaft with bell-crank rockers, the ends of which, where in contact with the valve spindles, are lubricated under pressure. Easy means of adjustment and replacement of valve springs are provided. The cam shaft is driven at the front end by a twin roller chain from the crank shaft, and this chain has means for automatic adjustment. The method of driving the auxiliaries is original. It is by a horizontal spindle on the right-hand side of the engine. This spindle is driven by means of chains and, in turn, drives a vertical spindle through skew gears. On the top of this spindle is the magneto, while at the bottom of it is the spur gear pump, which deals with the oil for lubrication purposes. Being outside the sump, the pump is easy of access for dismantling, and is self-priming. Further along the horizontal spindle, to which reference has been made, is the dynamo, and, finally, the water-circulating impeller, which is of the screw type. Bolted to the rear of the engine is a bell housing, in which are enclosed the fly-wheel and the starting motor. Within the fly-wheel is a single plate clutch with cork inserts. This clutch runs in oil. The crank shaft is very carefully balanced and is carried in six bearings, and the engine develops 18·5 horse-power at 1000 revolutions per minute and 52 horse-power at 3200 revolutions per minute.

21–60 Horse-power Eight-cylinder Wolseley.

The eight-cylinder car is still looked upon as a distinct luxury in this country, but in spite of that, there has been a steady increase in the number of such cars on our roads during the last twelve months. The majority of them, however, have been of foreign manufacture, and the arrival of the moderate-priced eight-cylinder Wolseley is therefore interesting. This car, which is undoubtedly one of the most striking exhibits at the Show, is illustrated in Figs. 15–17. The straight eight Wolseley has been designed with an eye to cheapening production in that many of the smaller component parts, such as pistons, connecting-rods, valves and springs, are interchangeable with those of the six-cylinder two-litre model, introduced by the same firm last year. The cylinders have a bore and stroke of 65 mm. by 101 mm. respectively, having a total capacity of 2681 c.c., and a Treasury rating of £21. The cylinder block is cast integral with the top half of the crank case carrying the crank shaft in ten white-metalled bearings. An unusual feature of these bearings is that the end bearings consist of solid bushes, while the others are capped split shells. These bearings are not constructed to be taken up, and when wear occurs it is necessary to fit a new set. The eight-throw crank shaft is of the 2–4–2 type, and the firing order adopted is 1, 3, 7, 4, 8, 6, 2, and 5. The crank shaft is composed of two portions united in the centre and a vibration damper is fitted on its front end. The overhead cam shaft is driven through a spiral bevel 2–1 reduction gear by a vertical shaft, which is driven from the middle of the length of the crank shaft. Over the joint in the crank shaft is assembled a unit carrying two spiral bevel gears, one of which drives the vertical shaft and the other the oil pump. The generator and Lucas coil distributor, accessibly situated on the near and off sides respectively, are driven by another set of spiral bevel gears. The distributor is set vertically and driven by a 2–1 reduction gear, the generator running at engine speed. The valves are operated from the cam shaft through pivoted levers in the usual manner. Three-ring aluminium pistons and duralumin connecting-rods are employed. Lubrication is afforded by means of a gear type pump—driven from the crank shaft as already described—which delivers oil at a pressure of 70 lb. to 80 lb. per square inch to the ten main bearings and through the drilled crank shaft to the big ends. Two external oil pipes convey the oil to the overhead cam shaft and rocker gear. The Lucas coil ignition set incorporates an automatic ignition control, as well as the usual hand-operated control lever on the steering wheel, giving probably a wider ignition control than is usually necessary. The exhaust and inlet manifolds are neatly arranged on the near side of the engine, the exhaust manifold



FIGS. 16 AND 17—ENGINE OF 21-60 H.P. 8-CYLINDER WOLSELEY CAR

* No. I. appeared October 14th.

being provided with two outlets, one at each end. A single S.U. carburetter is bolted to the centre of the inlet manifold, the ingoing charge impinging against

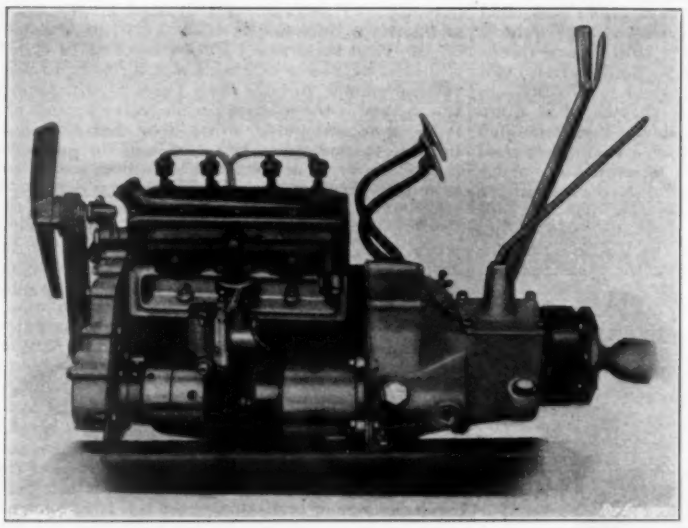


FIG. 18—NEAR SIDE OF 7 H.P. TRIUMPH POWER UNIT

a hot spot formed by bringing the two manifolds into contact at the centre. The inlet manifold is divided longitudinally by internal webs and each pair of cylinders is supplied by a common passage. Cooling is by thermo-syphon, assisted by a water impeller housed on the fan spindle and driven from the crank shaft by belt. The power unit is suspended in the frame on rubber mountings from three points. The drive is taken through a single dry-plate clutch to a four-speed centrally-controlled gear box forming a unit with the engine and providing ratios of 19·2, 11·65, 7·72, and 5 to 1. The final drive is taken through an open tubular propeller shaft to a semi-floating spiral bevel rear axle. Steering is by worm and wheel and semi-elliptic springs are provided, both front and rear, assisted by shock absorbers. The chassis frame is of usual construction, tapering slightly from front to rear, and upswept over the rear axle. Four wheel brakes of the internal expanding type are fitted and operated through cables by the foot pedal. The hand lever, which is placed on the right of the driver, brings a separate pair of shoes into action in each rear wheel. The carburetter is fed from a 14-gallon petrol tank placed across the rear of the chassis by means of an Autovac. The 12-volt starting and lighting set is by Lucas. The car is equipped with a head lamp dipping device, and represents remarkable value when compared with a number of the six-cylinder cars on the market.

7 H.P. Triumph.

As the result of the increasing popularity of the small car, it is noticeable that several well-known firms have turned their attention to this subject, and amongst them is the Triumph Company, of Coventry. The Triumph Super Seven possesses several interesting features not usually found on a car of this power. The engine—Fig. 18—has a bore and stroke of 56·5 mm. by 83 mm. respectively, giving a total capacity of 832 c.c. and a Treasury rating of £8. The cylinders, together with the top half of the crank case, are cast *en bloc*, providing three bearings for both the crank shaft and cam shaft. The base of the engine is closed by a pressed steel sump,

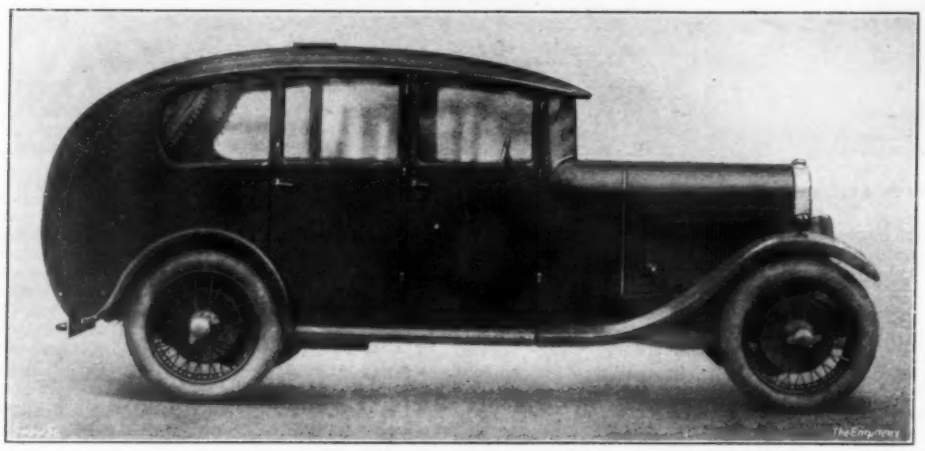


FIG. 19—16-60 H.P. 6-CYLINDER VULCAN SALOON

a gauze filter tray being clipped between the crank case and the sump joint. The detachable cylinder head incorporates combustion chambers of the "turbulent" shape, and the sparking plugs are placed centrally over the cylinder bores. Side-by-side valves are employed, the valve gear being totally enclosed in the usual manner. Duralumin connecting-rods and aluminium pistons are used, the latter having two rings in the top and a scraper ring in the skirt. The cam shaft and magneto are driven through a triangulated drive by roller chain from the front end of the crank shaft, an automatic tensioning device being incorporated in this drive. The dynamo is driven separately by roller chain from the crank shaft. Lubrication is effected by means of a submerged gear pump, surrounded by a cylindrical filter, and driven from the cam shaft by a vertical spindle through spiral gears. Oil is delivered under a pressure of about 30 lb. per square inch to the crank shaft and cam shaft bearings, the big ends being supplied through thedrilled crank shaft. No pipes are employed in the oiling system, as the oil is forced through drilled passages in the crank case casting. The roller chains are lubricated from the oil relief valve, situated at the front of the engine. Both inlet and exhaust manifolds are situated on the near side of the engine. The inlet system is arranged so that the leads actually pass through a portion of the exhaust manifold on their way to the cylinders. A vertical Amac carburetter is employed, and is supplied from a 4-gallon petrol tank fitted inside the bonnet. Cooling is by thermo-syphon assisted by a two-bladed fan driven by a flat belt from the crank shaft. Unit construction is employed for the engine clutch and gear-box, and the mounting of the unit in the frame is interesting. Vertical steel plates are bolted to the front and rear ends of the cylinder crank case casting, these plates being long enough to rest upon brackets attached to the chassis members. The drive is taken through a single plate to the centrally controlled three-speed gear box having ratios of 17·06, 9·54 and 5·25 to 1. An internally expanding transmission brake is arranged behind the gear-box and controlled by a central lever. A Hardy disc flexible joint is attached to the rear of the transmission brake drum, concentric with a ball locating device for the forward end of the propeller shaft. Behind this joint the propeller shaft is encased within a torque tube, forming part of the rear axle assembly. The final drive is by an underslung worm-driven rear axle. The speedometer drive is taken from the front end of the torque tube. Semi-elliptic springs are employed at the front and quarter-elliptic at the rear. One centrally-disposed friction type shock absorber is fitted above the front axle and two are fitted at the rear and lie parallel to the quarter-elliptic springs. Hydraulically-operated internal-expanding four-wheel brakes working on the Lockheed principle are used. The master cylinder is mounted on the chassis and operated directly by the foot pedal. Pipes leading from the master cylinder are taken along the frame to further flexible pipes connected to the operating mechanism within the brake drums. Steering is by worm and complete wheel. The standard equipment includes a 6-volt starting and three-lamp lighting set.

16–60 Horse-power Six-cylinder Vulcan.

The 16–60 horse-power six-cylinder Vulcan—Fig. 19—possesses several interesting features in

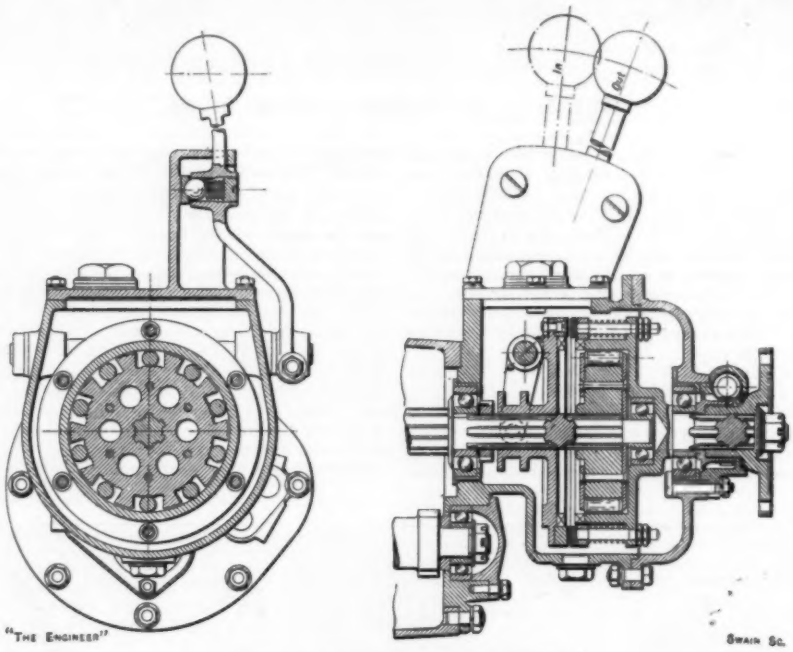


FIG. 20—VULCAN FREE-WHEEL DEVICE

both body and chassis design. The engine has a bore and stroke of 65 mm. by 100 mm. respectively, giving a total capacity of 1990 c.c., and a Treasury rating of £16. The cylinders are cast *en bloc*, and are mounted on an aluminium crank case which provides seven bearings for the crank shaft. Mounted on the detachable cylinder head at 90 deg. apart are two cam shafts which serve to operate the inlet and exhaust valves. The sparking plugs are placed centrally over the cylinder bores. The crank shaft is of the circular web type, machined all over and fitted with a vibration damper at its front end. Lubrication is by means of two gear pumps, mounted in tandem on the timing case cover, and drawing oil from the aluminium sump. The larger of the two pumps delivers oil under pressure to the main bearings and big ends, while the other feeds the overhead cam shafts. The provision of two oil pumps is to obviate any possibility of the supply to the cam shaft "starving" the supply to the main bearings. Ignition is by means of a Duplex magneto, incorporating an automatic ignition control. Cooling is by thermo syphon. Unit construction is employed for the engine clutch and gear-box. The drive is taken through a single dry plate clutch to a right-hand controlled four-speed gear-box, giving ratios of 5, 8·45, 12·85 and 18·25 to 1.

From the gear-box the drive passes through a free-wheel device—Fig. 20—housed in an extension to the rear of the gear-box. This device contains a roller ratchet mechanism which is fitted on the gear tail shaft. On the outer periphery of this member is cut a number of face serrations, which can be meshed with corresponding serrations on the driven

component splined to the tail shaft. When these two members are brought together by a lever, placed conveniently on the driver's left-hand side, the drive to the rear axle is solid, but when they are separated the car can overrun the engine.

Many advantages are claimed for this device, such as lower fuel consumption, the pleasant and noiseless manner in which the car will glide down slight inclines, but the chief advantage lies in the easy way one is able to change gears with this device in use and whilst the car is in motion, without using the main clutch, merely by decelerating the engine as the gear lever is moved. When the free-wheel device is locked, the car is driven in a normal manner. The final drive from the free-wheel device is taken through metal

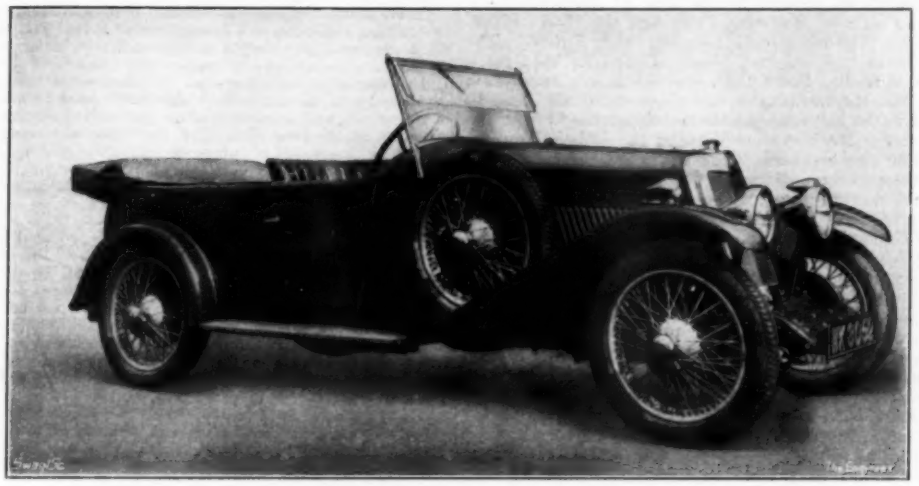


FIG. 21—12 H.P. SUPERCHARGED LEA FRANCIS CAR

universal joints and an open tubular propeller shaft to a spiral bevel rear axle. The carburetter is fed by Autovac from a 10-gallon petrol tank carried across the rear of the chassis.

Internal expanding four-wheel brakes operated by the foot pedal and assisted by vacuum-operated servo are employed, the hand brake acting on the rear wheels only. Semi-elliptic springs assisted by shock absorbers are fitted both front and rear. The equipment includes a 12-volt starting and lighting set and dipping head lights. The unconventional fabric saloon body has been designed with the intention of having nothing projecting or carried outside the body and to utilise all the available chassis space for the body. In fact, the body embraces the full width of the car. The rear wings are sunk in the body sides, and the running boards are actually inside the car, and are not visible until the doors are opened. A large compartment for luggage together with a

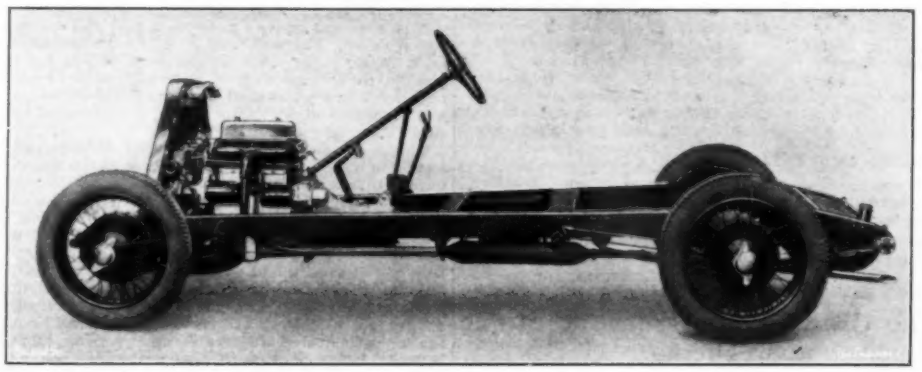


FIG. 22—CHASSIS OF 12 H.P. SUPERCHARGED LEA FRANCIS CAR

separate receptacle for the spare wheel is formed in the bulbous rear portion of the body, to which access is gained from the outside through flush-fitting detachable panels. The windscreen is of the two-panel V type, and, owing to the width of the body, an excellent range of vision is obtained from the driving seat. The driving position is rendered extremely comfortable by bringing the steering wheel into practically a vertical position by fitting a universal joint midway up the steering column.

12 Horse-power Supercharged Lea Francis.

Lea Francis, Ltd., of Coventry, is exhibiting a very wide range of cars, amongst which is a 12 horse-power supercharged sports car—Figs. 21 and 22—fitted with an attractive fabric-covered touring body. This car is, we understand, the first of standard British make to be offered to the public with a supercharged engine. With the exception of the supercharger, it is almost identical with the 12–50 horse-power chassis. Both have four-cylinder monobloc engines, having a bore and stroke of 69 mm. by 100 mm. respectively, giving a total capacity of 1496 c.c. and a Treasury rating of £12. The cylinder head is detachable and push-rod operated overhead valves are employed. The top half of the aluminium crank case supports the crank shaft and cam shaft in three bearings. Duralumin connecting-rods and aluminium alloy pistons are fitted. Unit construction is employed for the engine, clutch and gear-box. The drive is taken through a single plate clutch to a four-speed gear-box provided with a right-hand gear change and the ratios provided are 4·27, 5·56, 8·47 and 14·23 to 1. The final drive is taken through an open tubular propeller shaft to a spiral bevel rear axle, the casing of which is made of aluminium. Semi-elliptic springs and shock absorbers are fitted both at the front and rear, the torque and drive being taken through the rear springs, which are underslung.

Lubrication is afforded by a gear type of pump submerged in the sump, delivering oil under pressure to the main bearings, big ends, cam shaft bearings and overhead valve gear, the oil being first passed through a pressure filter which is readily accessible for the purpose of cleaning. Ignition is by means of a Lucas magneto placed at the front of the engine on the off-side and cooling is effected by pump circulation

The essential difference between the two cars is that the power unit on the 12 horse-power supercharged car is set back in the chassis in order to accommodate the Cozette blower, and the engine is modified to meet the increased stresses involved. The blower has a paddle type rotor and is quiet in operation. It is vertically disposed in front of the engine and driven at engine speed through a pair of bevel pinions from the crank shaft. The housing for the drive forms part of the timing case cover and also provides a means of support for the blower. A Cozette carburetter is bolted direct to the blower casing on the near side and is fed from the 10-gallon petrol tank situated across the rear of the chassis by an electrically driven Autopulse pump. A small oil pump bolted to the top of the supercharger serves to lubricate the rotor and is fed from an auxiliary tank attached to the engine side of the dashboard and is simultaneously controlled with the throttle. The induction, or delivery, pipe is bolted to the off-side of the blower casing and to the usual carburetter flange on the off-side of the cylinder block.

To realise the increase in power obtained by supercharging one only has to compare the 70 brake horse-power developed at 4500 revolutions per minute by the 12 horse-power supercharged model with the 50 brake horse-power developed by the 12–50 horse-power model at the same number of revolutions.

Four-wheel brakes of the internal expanding type operated by the foot pedal and assisted by Dewandre-Servo, together with a hand brake operating on the rear wheels only are provided. A 12-volt C.A.V. lighting and starting set is provided. Special care has been taken in designing this chassis to obtain a low floor height for the body, with the result that the top of the frame members are only 17in. from the ground.

The touring body fitted to the supercharged car is somewhat of a novelty in that it is covered throughout with fabric. Additional leg room has been provided for the rear passengers by forming a well in the floor of the rear compartment, on either side of the centre portion, this latter being left to give clearance to the propeller shaft.

9 Horse-power Standard.

The Standard Company, of Coventry, in adding a 9 horse-power car to its existing range, has re-entered the field of small car makers. The 9 horse-power Standard has a four-cylinder engine having a bore and stroke of 60 mm. by 102 mm. respectively, giving a total capacity of 1155 c.c. and a Treasury rating of £9. The cylinder block is cast integral with the top half of the crank case, carrying the crank shaft in two bearings. Side-by-side valves are used and the tappets are provided with mushroom heads and housed in a recess in the crank case casting in the usual manner. Duralumin connecting-rods and aluminium pistons are employed. Lubrication is afforded by a gear-type pump mounted on the exterior of the crank case on the near side and is easily detachable. Oil is fed under pressure to the crank shaft and cam shaft bearings through drilled passages in the crank case, the big ends being supplied from the main bearings through the drilled crank shaft. The only internal oil pipe in the system is that on the suction side of the pump. This pipe is surrounded by a filter gauze attached to the sump drain plug and is easily removable for cleaning purposes. There is also a filter tray of the usual type in the sump, the oil being filtered twice during its circulation. The dynamo and magneto are situated on the near side of the engine, the former being driven from the front end crank shaft by a triangularly-disposed roller chain, this chain also serving to drive the cam shaft. The timing case is a steel stamping. A Zenith carburetter is bolted direct to the cylinder block on the off side, and is fed by gravity from a 6-gallon petrol tank attached to the forward side of the dashboard. The engine, clutch and gear-box are of unit construction and three-point suspension is adopted. The drive is taken through a disc clutch to a three-speed centrally controlled gear-box giving ratios of 5, 9·3, and 20 to 1. The final drive is by means of an open tubular propeller shaft to an underslung worm-driven rear axle. Semi-elliptic springs are provided both front and rear. Internal expanding four-wheel brakes are fitted and are operated by both the centrally placed hand lever and foot pedal. A 12-volt Lucas starting and five-lamp lighting set is included in the equipment.

Westinghouse Vacuum Servo Brake.

We were interested in the vacuum servo braking system applied to petrol-driven vehicles shown by the Westinghouse Brake and Saxby Signal Company, Ltd., King's Cross, London. Illustrations of this apparatus are given in Figs. 23, 24 and 25. It uses as its source of power the pressure of the atmosphere, operating against the partial vacuum created by the pistons of the engine on the suction stroke when the throttle is closed. A control valve operated by the brake pedal regulates the degree of vacuum on one

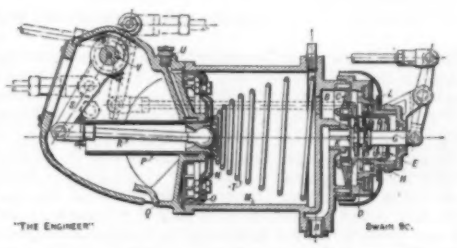


FIG. 23—CONTROL VALVE AND BRAKE CYLINDER

side of the brake piston shown in the sectional view, the other side being always open to the atmosphere. The piston-rod is connected to the brake gear and the application and release of the brakes are dependent on the degree of vacuum on the one side of the piston. The brake cylinders are made in different sizes to suit the weight of vehicle. In the sectional illustration of the control valve and brake cylinder, the orifice A in the control valve is connected with the induction pipe, while B communicates with the brake cylinder. The diaphragm C communicates on one side with the atmosphere by way of D and on the other side with the brake cylinder by way of B. The hollow guide E, of which the interior communicates with the atmosphere by orifices F and D, is fixed to the diaphragm. The valve K controls the passage between the induction pipe and the brake cylinder and another valve L controls the passage from the brake cylinder to the atmosphere. In the normal or "release" position, the valve K is seated while the valve L is off its seat. In these conditions the brake cylinder is in free communication with the atmosphere by the

valve L and orifices F and D. The pull by the brake pedal on the spindle G is transmitted through the spring H to the guide E, diaphragm C to the valve L, thus closing the passage between the brake cylinder and the atmosphere. The guide E continuing its upward movement raises K off its seat and the brake cylinder chamber is put in communication with the induction pipe of the engine, which produces a partial vacuum and determines the amount of pull on the brake rigging. This reduction of pressure tends to counteract the pull of the spindle G. If the vacuum thus produced momentarily exceeds the pull of the spindle G, the guide E is pulled by the diaphragm and unseats the valve L, allowing the readmission of air into the brake cylinder, and thus partially destroying the vacuum. On the other hand, if the vacuum is insufficient the pull exercised by the spindle G operates on the diaphragm and guide E, and causes the valves K to open, thereby increasing the degree of vacuum.

With regard to the brake cylinder, this contains a piston N with leather packing O and with a hollow stem P, guided in the end cover Q of the cylinder.

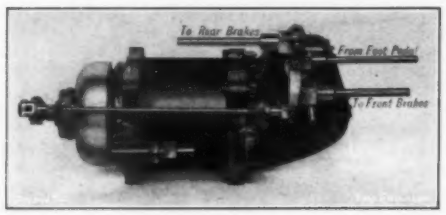


FIG. 24—WESTINGHOUSE VACUUM SERVO-BRAKE CYLINDER

The pull rod R has a spherical end to allow of adjustment to the angular motion of the lever S. The spring T is to assist in releasing the brake. A shaft V is extended through the casing Q and supports a double-ended lever W, Fig. 25, one end of which is connected to the front brakes and the other end to the rear brakes. From the upper end is suspended a lever X Y Z. The pedal is connected by a rod to the point Y and the control valve to Z, which shows the lay-out of the braking system. Projections on the central bosses of the lever W engage with a projection formed on the shaft V, lost motion being arranged so that, in the event of the vacuum servo being cut out, the foot brake may be operated without causing any movement of the shaft V and the lever S. A stop is arranged to provide a fulcrum at the end Z of the lever X Y Z.

The driver presses on the pedal, which is connected at the point Y, to the balancing lever X Y Z—Fig. 25.

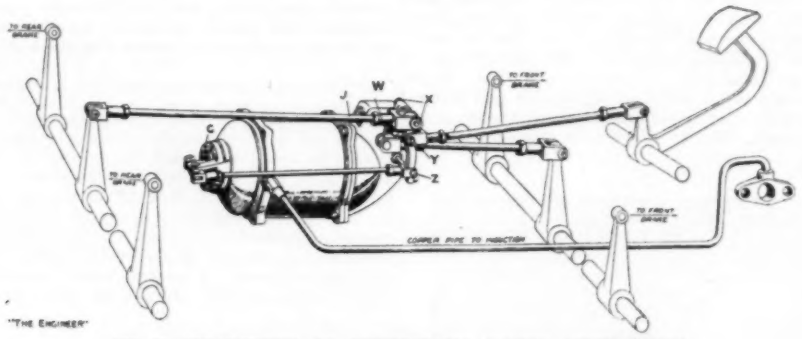


FIG. 25—ARRANGEMENT OF WESTINGHOUSE VACUUM SERVO-BRAKE

One end of this lever is connected at X to the mechanical brake pull rod J, and at the other end Z to a rod by which the pull is transmitted to the spindle G of the control valve. The point Y being situated near the end X the initial movement of the pedal acts on the pull rod J until the brake shoes are in contact with the brake drums and any slack in the brake rigging is taken up. Thereupon the point X becomes fixed, and the balancing lever X Y Z rotates on point X and point Z moves to the right, thus pulling out the spindle G of the control valve. This causes communication to be opened between the induction pipe of the engine and the left-hand end of the brake cylinder which is then subject to a partial vacuum. As the right-hand end of the cylinder is always open to atmosphere, the piston moves towards the left, and with it the vacuum brake pull rod, thus applying the brake. When the driver releases the pedal the point Z moves to the left, communication is cut off between the engine induction pipe and the left-hand end of the brake cylinder, and, the latter being again open to atmosphere, the brake is released. The driver, in operating the pedal, controls the vacuum brake and the mechanical brake simultaneously through the balancing lever X Y Z, and in event of the vacuum failing, the mechanical brake is applied in the ordinary way. It will be seen that so long as the driver maintains a certain pressure on the pedal, the braking force remains constant. As soon as he lessens the pedal pressure the braking force becomes proportionately less, and as soon as he increases the pressure the braking force correspondingly increases. He can therefore at all times feel the degree of braking, since this depends on the pressure which he exercises on the pedal.

Obituary.

ELIOT HOWARD.

We much regret to have to put on record the death of Mr. Eliot Howard, the chairman of Hayward-Tyler and Co., Ltd., which took place on the 8th inst.

Mr. Howard was born in 1842, and was therefore upwards of eighty-five years of age at the time of his death. He was educated at Grove House, Tottenham, and served his time at the Millwall Ironworks, when that establishment was building H.M.S. Northumberland, and rolling the plates for H.M.S. Warrior—the first two ironclads for the British Navy.

In 1863 he joined his brother, the late Mr. R. L. Howard, as partner in the firm of Hayward-Tyler and Co., now Hayward-Tyler and Co., Ltd., of 99, Queen Victoria-street, London, and Luton. The business had originally been started in 1815 by a Mr. Russell. From 1835 to 1855 it was carried on by Mr. Hayward-Tyler in succession to Mr. Russell, and in the last-named year it was purchased from the widow of Mr. Hayward-Tyler by Mr. Robert Howard.

The two brothers, R. L. and Eliot, between them developed the well-known business of hydraulic engineers and of mineral water machinery manufacturers, two of their specialities being hydraulic presses and continuous process soda water machines, as designed by Joseph Bramah. It was due to Mr. Eliot's initiative that the firm undertook the manufacture of the "Universal" steam pumps in 1869, one of the earliest single-cylinder steam pumps to be manufactured in Europe, and later the duplex type, which has since been specially adapted for cargo oil and other marine purposes, as also for land work in connection with large and small oil installations at home and abroad.

From 1815 to 1839, the work of the firm was carried on at Milton-street, London, but a move was then made to Whitecross-street. In 1871, however, it was found impossible to develop further in that position, and large works were built at Luton. Manufacturing was thereafter gradually transferred to Luton, and the London works were finally closed in 1904.

In 1905 the business was turned into a private limited company, Mr. Eliot Howard being one of the first directors. He became chairman in 1916, and retained that position to the time of his death, after a connection of sixty-four years with the business.

Mr. Howard became a member of the Institution of Mechanical Engineers in 1864, and was for some time the oldest surviving member. He was a Justice of the Peace and a Deputy Lieutenant. In his early days he was a keen mountaineer, and was a member of the Alpine Club from its early days, but a shooting accident in which he lost the sight of one eye in 1869 put an end to his activities in this direction.

The Grand Falls Hydraulic Power Scheme.

(By our Correspondent in Canada.)

Several huge hydro-electric power projects are at present under way in Canada. One of the most notable of them is the development at Grand Falls, on the Saint John River, in the province of New Brunswick, where a plant is being erected by the Saint John River Power Company. Construction of this plant was begun in August, 1926. The work was continued through the winter of 1926–27, and should be completed by the summer of 1928.

Grand Falls is 225 miles from the mouth of the Saint John River, which at this point flows over a shear drop of 70ft., and in the chasm below, which bends around the town of Grand Falls, has an additional descent of 50ft. The river above Grand Falls is an international stream, and the more important storages are situated in the province of Quebec, and in the State of Maine, in the United States. Owing to these considerations, many complications, which are not usually factors in projects of this nature, entered into the Grand Falls scheme. Negotiations had to be entered into with the Federal Government and the Government of Quebec, and a reference had also to be prepared for submission to the International Joint Commission, which had to deal with the international aspects of the situation.

The town of Grand Falls, adjacent to the power site, is built on a neck of land, which is surrounded on three sides by the river. The natural falls in the river between the upper and lower basin is approximately 112ft., but the construction of a dam just above the falls will increase the average gross head to 132ft. The development works consist of this control dam above the falls, a pressure tunnel 2700ft. long through the rock underlying the town from the upper to the lower basin, steel penstocks leading from the tunnel to the turbines, and a power-house designed for three generating units, each of 20,000 horse-power. The wide variation in natural discharge of the Saint John River makes the Grand Falls development essentially a storage undertaking.

To increase the natural low-water flow the company is constructing a storage reservoir in the Temiscouata Basin on the Madawaska River, one of the large tributaries which rises in Quebec and flows into the Saint John River, a considerable distance above Grand Falls. This reservoir will impound water during the flood period, and by so doing will partly reduce floods which have occurred nearly every spring, and will be of benefit to the province in lessening the damages resulting from the floods.

On account of especially favourable topographic and rock foundation, the main or control dam* at Grand Falls will be a comparatively simple structure. It is being built across the river about 200ft. above the crest of the falls, and consists of ten main piers and two abutments, the latter connected with the shore to the high-water mark by means of a retaining wall at one end of the dam and of the intake structure at the other end. The main piers are being so spaced as to provide openings of 48ft. clear width, controlled by steel sluice gates of the Stoney type. An eleventh opening immediately adjacent to the intake is provided with two intermediate piers, forming three openings, each of 16ft. clear width. These three small openings will be utilised for regulating purposes during ordinary stages of flow. The overall length of the dam, from intake structure to retaining wall, will be 652ft. The dam is designed to maintain the water level at the height of 427ft. above mean sea level. The river bed at the dam site lies at elevations from 396 to 412. The maximum flood water level that has ever been recorded for the upper basin was 427·26. The top surface of the piers of the dam will be at elevation 434. At the southern end of the dam the water is diverted into the tunnel through a flared or funnel-shaped intake, across the mouth of which there will be a series of piers and abutments, forming openings which will be protected against floating material by deeply submerged curtain walls, emergency steel stoplogs, and steel racks inserted between the piers.

The tunnel connecting the intake with the penstocks, which is now under construction, will be the largest pressure conduit in Canada. It will have a clear height and width of 23ft. Between transition sections it will be of horseshoe shape. The horseshoe section will have a finished area equivalent to a circular section of approximately 23·5ft. diameter. The tunnel will lie from 100ft. to 250ft. below ground level, and have a rock covering of about 100ft. depth. It is being excavated entirely in rock, and is being lined throughout with concrete in order to resist rock slips and to reduce the loss of head. For the sides and arch of the tunnel lining, steel forms are being used, and the entire space at the back of the forms is being filled with concrete placed by the pneumatic process, the air pressure being so regulated as to ensure the filling of all holes, and at the same time to provide a smooth and unpitted surface on all showing faces.

It may be mentioned here that the first scheme studied for Grand Falls included a canal instead of a tunnel, and the open waterway was found feasible for the proposed initial development, but factors other than the engineering economics of the initial development alone had to be taken into consideration. A large part of the Saint John River drainage basin above Grand Falls lies in the State of Maine, and in order to develop the river to its maximum capacity—125,000 horse-power—at Grand Falls, considerable artificial storage will be required in Maine. The storage required to develop 60,000 or 75,000 horse-power will be obtained entirely in Canada and on international watercourses. Although a canal might have been employed for a 75,000 horse-power development, it was not found feasible to enlarge such a waterway to accommodate possible future augmented flow from Maine storage, nor was it considered physically proper or economical to construct a second canal.

The penstock section of the initial development will consist of a steel pipe, 23ft. in diameter at the tunnel end, terminating in a three-way breeches pipe from which separate penstocks, each 14ft. in diameter, will lead into the power-house. All of the penstock structure will be of steel plate, encased in concrete. The tunnel end of the penstock will form a steel liner projecting 100ft. into the bore of the tunnel, and will be grouted into place. Just ahead of the distributor there will be a tee connection on the upper side of the penstock, above which the steel plate differential surge tank will be built. This will be one of the largest elevated surge tanks in America. It will be between 50ft. and 55ft. in diameter.

The power-house will be entirely of concrete, and will have only one operating floor for both turbines and generators, thus reducing to a minimum the number of men required for operation. The unfinished end of the power-house will be protected against the rise of the river by the construction of brick bulkheads. A temporary end wall will be constructed between the positions of units No. 2 and No. 3 to enclose completely the end of the power-house above high water. This wall will be of wood and structural steel. The location of the power-house permits of its extension for housing a total of six units.

The power to be developed at Grand Falls will be transmitted to St. John, Fredericton, and other municipalities, and will also be sold to existing and proposed pulp and paper mills and other industries in the province.

The work is being carried out under the supervision of Mr. A. H. White, chief engineer of the International Paper Company, which holds the controlling interest in the Saint John River Power Company. Associated with White is Dr. H. G. Acres, Consulting Engineer to the Ontario Hydro-Electric Power Commission. The general contract was awarded to the Dominion Construction Company, of Montreal, at 1,546,556 dollars. For the entire development, including turbines and electrical equipment, the engineers' estimate for an initial installed capacity of 60,000 horse-power is 7,900,000 dollars.

On page 456 we give several views of the works.

* In this country the structure would be described as a barrage.

Railway Matters.

Railway engineers will be interested to hear that the recipient of the Crampton Prize awarded, as related on page 405 of The Engineer of October 7th, by the Institution of Civil Engineers, is Mr. D. McLellan, the divisional engineer for Scotland of the London, Midland and Scottish Railway.

A message from Johannesburg states that the tender of a Belgian firm has been recommended for acceptance in respect of fifty fruit wagons for the Union Railways. The price quoted is £26,750. It is understood American tenders varied from £33,750 to £40,000, and the German tenders were at prices somewhat between these figures. The only British firm competing quoted at a rate 50 per cent. higher than the Belgian tender recommended for acceptance.

In that chapter, "Railways Supplement Canals," of our series "One Hundred Years of British Railways," which appeared in our issue of July 11th, 1924, we referred to the Peak Forest Tramway, which the Peak Forest Canal Company built under powers obtained in 1794. The line was laid out by Benjamin Outram, and a section of the original track, together with a truck with flangeless wheels, have now been added to the Railway Museum at York.

The earnings of the South African Railways for the week ended September 10th amounted to the extraordinarily high figure of £522,398. This figure is the third highest ever recorded in the history of the railways. The highest amount ever earned in one week was £536,448, which was gained in the week ended December 11th, 1926. The increase is due largely to goods and mineral traffic, and the transportation of the maize crop to the coast, which is now well in progress, accounts for a considerable amount.

In order to allow the new lines for the Wimbledon–Sutton line of the Southern Railway to be laid, the whole of Wimbledon Station is being rearranged and extended. The up main platform and all the station buildings thereon have now disappeared. The up main line is served by an island platform, access to which is no longer gained from the cab-yard level but from the overbridge that serves the other five through lines. In addition to providing for the Wimbledon and Sutton Railway, the whole station is undergoing its long-promised reconstruction, at a cost, as reported in this column on December 18th, 1925, of £250,000.

Mention was made in this column of our issue of August 19th of experiments being made by the London and North-Eastern Railway with steam rail cars of the Sentinel-Cammell and the Clayton types. Twenty units of the former had just been ordered, and it was proposed to get a further thirty of one or other type. It is announced that ten Clayton steam rail coaches have now been ordered. The merits of this class of transport lie in the small coal consumption, and that only a driver and a conductor are necessary. The service can therefore be fairly frequent, and so compete more effectively, than can regular trains, with road services.

Speaking at a dinner on the 12th inst. the Home Secretary said that a very difficult question was coming before Parliament next session with regard to the application by the railways for permission to indulge in the luxury of motor traffic. He was not there to express the view of the Government upon Bills they had not seen, but he desired to state that any increase of facilities for railway companies to indulge in motor traffic would place an enormous new burden on the roads of the country. Those who were responsible for advising Parliament as to the course it should take in regard to such Bills must consider the absolute necessity of bringing the roads up to standard before the new industrial vehicles came upon them.

The Railway Information Bureau has taken the very wise step of drawing attention to the fact that railway charges now are fixed by the Railway Rates Tribunal and not by the companies. Further, that under the Railways Act, 1921, the charges have to be regularly reviewed, and, if necessary, revised. The Act provides that the rates, fares, &c., shall be such as shall produce a net revenue equal to that of 1913 with certain additions to meet the capital expenditure since. It, however, says also that if the new revenue produces more than that laid down the charges are to be reduced to an extent of 80 per cent. of the surplus. We would add that, on the other hand, there is nothing to guarantee the 1913 returns, as there is a limit to which the companies can raise their rates.

The Metropolitan Railway is following the example of the larger companies; it is naming its locomotives—at least, those electrically operated. The names chosen are mainly of historic personages, who have been associated with the territory served by the Metropolitan. The following is the first list:—William Penn, John Hampden, John Lyon, Dick Whittington, John Milton, Michael Faraday, Oliver Cromwell, Benjamin Disraeli, "Sherlock Holmes," Charles Dickens, Sir Christopher Wren, Sarah Siddons, George Romney, Sir Ralph Verney, Lord Byron, Sir Francis Drake, Edmund Burke, John Wycliffe, B. E. E. 1924. The last is to commemorate the British Empire Exhibition of 1924, and it will be borne by the engine shown there which will further carry the symbol of the Exhibition Lion.

The London and North-Eastern Railway Company announces that Sir John Rumney Nicholson, C.M.G., has intimated his desire to retire, at the end of the year, from his position as docks engineer for the North-Eastern area, including Grimsby and Immingham. At the request of the company he will, however, continue to act as consulting docks engineer for a further two years. Sir John was the chairman and chief engineer of the Singapore Harbour Board, and in February, 1920, was appointed as successor to Mr. Charles Watson, who died in August, 1915, docks engineer to the North-Eastern Railway, and his present appointment came to him on that company's incorporation in the London and North-Eastern. The new docks engineer is Mr. J. A. Wickham, who had a very wide and valuable experience of docks, railways and transport generally during the war, and who, when demobilised, held the rank of Brigadier-General. He joined the London and North-Eastern in 1924, and is now the Parliamentary assistant to the chief general manager.

Notes and Memoranda.

Using an antenna only 25ft. long which emitted waves having a frequency of 9140 kilocycles (32.8 m.), an experimental radio station in America has been heard all over the world. It has been picked up and re-broadcast in Australia. Such high-frequency waves have the peculiarity that they seem to skip over long distances and then for greater distances become clearly audible again.

The probable reserves of green talc at the main mine of the Kaapmuiden talc deposits in South Africa are estimated, on the present development work, to amount to between 21,000 and 26,000 tons. The possible resources cannot be more than guessed at, but should further development support the favourable indications already obtained, it is possible that over half a million tons will eventually be proved.

At the Westinghouse Research Laboratory a xylophone method is employed to test for soundness the carbon brushes for dynamos and motors. The brushes to be tested are laid on a base of felt and are lightly struck by a drum stick. They emit a characteristic note which enables the tester to distinguish weak brushes from strong ones. A high pitched note indicates a good quality of brush, but if the pitch is low the brush probably belongs to the weak or doubtful class.

A new hydraulic method of cleaning castings has been introduced at the Allis-Chalmers Manufacturing Company's works at Milwaukee, Wis. It consists of applying a stream of sand and water at a pressure of 425 lb. per square inch to the castings under treatment. It is stated that two men can now generally do the work which was previously done by sixty. A hydraulic turbine runner, for example, weighing 110 tons before and 40 tons after cleaning, is now cleaned in 14 hours instead of 300 hours.

The microscopic free-swimming larvæ of shipworms cannot develop in creosoted wood, as they are too delicately organised. Once developed, however, the presence of creosote in the wood does not deter them, as their galleries are quickly lined with impenetrable calcareous material. If small untreated spots exist on the surface of the wood where the creosote has failed to penetrate the wood because of the presence of knots, or because the wood was not evenly seasoned before the treatment, the larvæ can obtain foothold and at once extend their galleries through the wood, causing incalculable damage.

According to the latest return of the National Federation of Iron and Steel Manufacturers, the number of furnaces in blast at the end of September was 160, a net decrease of 5 since the beginning of the month. Production of pig iron in September amounted to 591,500 tons, compared with 596,100 tons in August and 645,800 tons in July. The production includes 195,900 tons of hematite, 205,400 tons of basic, 146,000 tons of foundry, and 20,500 tons of forge pig iron. The production of steel ingots and castings amounted to 777,000 tons in September, compared with 643,100 tons in August and 687,100 tons in July.

Suction discs have been successfully introduced for the purpose of lifting non-magnetic materials, such as glass, brass, copper, aluminium and other plates. In the cranes made by the Demag A.G. of Duisburg, the load is gripped by means of a number of concave suction discs, the rims of which are fitted with a packing. These are placed on the sheet to be raised, the air within them is partly extracted, and the atmospheric pressure is utilised to create an adhesion exceeding the weight of the sheet. The electrically driven pump for the air extraction is mounted on the crane carriage and is connected to the suction discs by a flexible pipe.

As a result of the efforts of the Council of Scientific and Industrial Research, a process is reported to have been developed whereby newsprint may be produced in Australia from domestic products at a price sufficiently low to enable it to compete with imported material. The Council has attempted to develop a method of producing newsprint and other grades of paper from local hardwoods, and the method evolved is believed in Australia to offer every prospect of commercial success. It consists of the use of a mixture of chemical pulp, specially prepared from eucalyptus timber, together with not more than 30 per cent. of mechanical pulp, made by grinding immature trees.

Announcement is made that the third unit in the Farmers, Quebec, hydro-electric plant of Gatineau Power Company has been turned over and is supplying power to the Gatineau mill of Canadian International Paper Company. The first unit was put in operation on May 8th, and the second on July 2nd. The Farmers power-house is designed for five generators of 24,000 H.P. each, of which four will be installed initially. The fifth unit will be installed as soon as the demand for electric energy justifies it. Three units in the Chelsea power-house of the company, a mile above Farmers, are also in operation, giving the company in the two plants a total of six units operating of an aggregate capacity of 174,000 H.P. The Farmers station utilises a gross head of 66ft., the natural head being augmented by a relatively low concrete dam built across the natural bed of the stream. The power-house on the east bank was erected on dry land, thus eliminating expensive cofferdamming operations.

An electric generator rated at 160,000 kilowatts is to be installed by the New York Edison Company in its power station at Fourteenth-street and East River. The generator, so states the General Electric Company, of Schenectady, will have a capacity nearly three times as large as any in service, and more than half again as large as any now under construction. It will be driven by a tandem compound steam turbine, comprising a single-flow high-pressure turbine element, a double-flow low-pressure turbine element, the electric generator, and a direct-connected exciter, all mounted on a continuous shaft. The new generator will be rated at 160,000 kilowatts at 1·00 power factor, 1500 r.p.m., three-phase, 25 cycles and 11,400 volts. The turbine will receive steam at a pressure of 400 lb. and a temperature of 700 deg. Fah., and will exhaust at 1in. absolute pressure. The length of the entire set will be 82ft. 7in., and will weigh 2,228,000 lb., or well over 1000 tons. It is proposed to complete the installation of the equipment by October 1st, 1928.

Miscellanea.

The cargo-handling equipment and wharves of St. John Harbour, New Brunswick, are to be extended considerably.

At St. John's College, Cambridge, there are lead heads bearing the date 1599 which continue to give as good service as when they were first fixed, as also do the lead stackpipes to which the heads are connected.

Last week the 10,000-ton motor vessel Siam of the East Asiatic Company of Copenhagen, called at Newcastle-on-Tyne to start a monthly service of motor vessels between the Tyne and the Western ports of North America.

We are informed that the Central Electricity Board has appointed Sir Reginald Blomfield to advise them on questions arising in connection with the design and colouring of the towers for carrying transmission lines.

The demand for space at the British Industries Fair, 1928, has so far surpassed all previous records, the total space let, at nearly four months before the opening, exceeding the area of the previous largest Fair—that of 1921, which followed a boom period in trade. Over 1400 firms have so far applied for exhibiting space.

It is announced that Harland and Wolff, Ltd., of Belfast, have received the order to supply the high-pressure boilers and geared-turbine propelling machinery for the 30,000-ton Holland-American liner Statendam, which was built at Belfast and is being completed at Wiltons, of Rotterdam. The work will, it is expected, occupy over a year.

What is claimed to be a record in building construction for the whole of North America was recently made in New Westminster, British Colombia. The building measures 133ft. by 70ft. and is 60ft. high. It is of concrete and required 1500 cubic yards of material. The whole structure was put up in sixty ordinary working days.

A new bascule bridge across the river Hull, to replace the existing North Bridge, is to form part of a large scheme of street improvement at Hull, and the Corporation Bridges Committee has accepted the tender of Widnes Foundry (1925), Ltd., amounting to £86,100, for its construction. The new bridge is to be completed in two and a-half years.

The boring operations at Crosby, near Maryport, Cumberland, which were commenced in the early part of this year on behalf of the Birkly Colliery Company, have recently been completed, and all the plant has now been taken away. Several boreholes were put down in various parts of the district, and one or two small seams were struck, but the results were, it is stated, not very encouraging.

On May 20th, 1927, 12·42in. of rain fell in the San Blas region of Panama, according to a report from the station at Nicuesa to the Panama Section of Surveys. The previous high record was 12·25in. on October 23rd, 1923. Rain fell every day during the month of May, except two. The total for the month was 56·33in. This has been exceeded only once on the Isthmus since rainfall records were kept in December, 1909, when 58·17in. fell at Porto Bello.

The inconvenience and losses resulting from the long drought in the South of France during the summer were so serious, notably the disastrous forest fires, that it has been found desirable to carry out the various schemes which have long been in abeyance for ensurng an adequate supply of water in the communes and particularly in the department of Hérault, for which purpose the Minister of Agriculture is asked to include in the next Budget estimates a sum of 75 million francs for the execution of the necessary works in the coming year.

On the eve of Sir Basil Zaharoff's departure for Paris, after his recent visit to London, the chairman of Vickers Ltd., on behalf of all the directors, on Thursday presented him with a cup on the completion of fifty years' connection with the company. The plinth bore the following inscription:—"Presented to Sir Basil Zaharoff, G.C.B., G.B.E., by the chairman and directors of Vickers Ltd., on the completion of fifty years' connection with the company, and as a mark of their great appreciation of the valuable work which he has done for them, and of their sincere gratitude and high esteem."

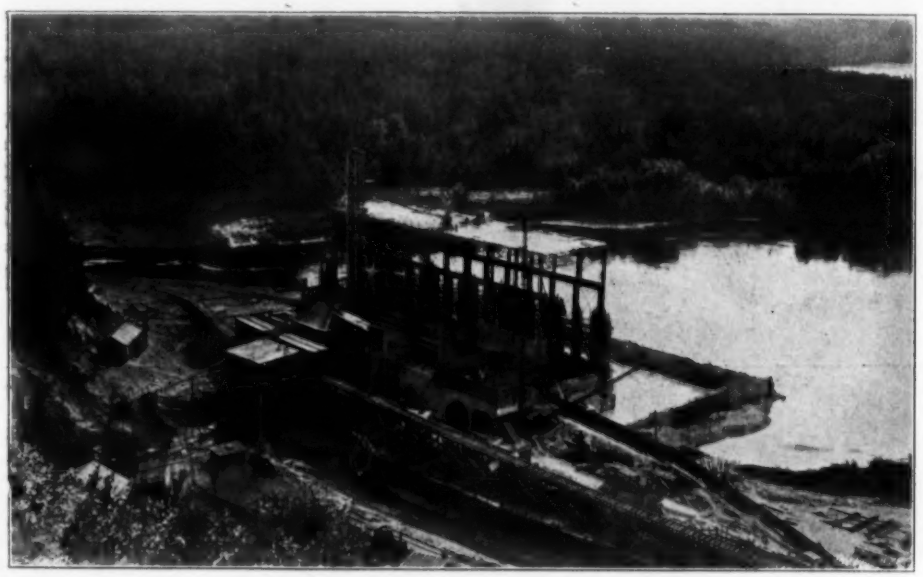
On September 6th a serious erection accident interrupted the construction of the Mississippi River bridge being built for the Missouri-Illinois Bridge Company, at Louisiana, Mo. Erection was in progress from the west or Missouri end. The semi-cantilever method of erection was, according to the *Engineering News-Record*, being used. One span had been swung and riveting was in progress; the second span was about two-thirds erected, when the two temporary bents carrying it gave way and the span fell into the river. One man of the erecting force lost his life in the fall. The span which fell was 314ft. in length.

H.M. Trade Commissioner in East Africa, Colonel W. H. Franklin, C.B.E., D.S.O., is desirous of receiving catalogues and price lists from United Kingdom firms engaged in the manufacture of agricultural and other machinery, engineering lines—including electrical—hardware, pottery and glassware. Catalogues may be sent direct to H.M. Trade Commissioner in East Africa, P.O. Box 220, Nairobi, Kenya, but the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, will be pleased to assist should any firm require further information as to what is required. Reference 19,928/1927 should be quoted by applicants.

What practically amounts to a new colliery is being developed by the Wankie Company, about 4 miles to the north-west of the present mine. The main coal seam at this point is 33ft. thick, and has been opened up by an incline shaft. The analysis of coal from this pit shows even better results than are being obtained from the present colliery. A branch line has been completed connecting this pit with the main line at a station called "Thomson," after the indefatigable general manager of the property. The new colliery is being equipped to deal with an initial output of 1000 tons per day, with provision for expansion up to 5000 tons per day. The contract for the equipment has, according to the *South African Mining and Engineering Journal*, been given to Simon Carves, Ltd., of Manchester, of which the South African agents are Messrs. J. and R. Niven.

HYDRO-ELECTRIC POWER PLANT AT GRAND FALLS, ST. JOHN RIVER, NEW BRUNSWICK

(*For description see page 454*)



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CONCRETE LINING OF TUNNEL, ARCH FORMS IN POSITION

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THE ENGINEER.

OCTOBER 21, 1927.

Labour Conditions in America.

ONE might search far for a more illuminating address on the position of labour in industry than that which occupies a large part of the admirable paper which Mr. Theodore W. Robinson, Vice-President of the Illinois Steel Company, read at the recent summer meeting of the Iron and Steel Institute. It made a profound impression upon its hearers, and we do not doubt that all who will take the very slight trouble that is needed to read it in our pages to-day will be as deeply interested. We need go no further back than the meeting which was held at the Mansion House on Monday last to find an example of the familiar character of debates upon Capital and Labour which take place in this country. They carry us nowhere. The speakers emit platitudes which have done service any time for the last half century; pious aspirations fill the air; old solutions and plans, which have already failed, times without number, are put forward, and the suggestion for the formation of yet another committee or board is advanced. All this profits nothing. No committee can achieve any useful purpose if the spirit of harmony does not exist commonly in the people, and if it does exist, there is no necessity for the committee. We have seen over and over again the best-devised schemes, the most sacred and binding contracts, the solemn indentures of permanent goodwill, reduced to ashes, until we are forced to the conclusion that all documents of the kind are fruitless. What is needed is a larger understanding of the potentialities which reside in a rational co-operation between Capital and Labour. Given that understanding and all the vain machinery which has been set up for the preservation of industrial peace will be as useless and antiquated as the laws against witches.

It is because Mr. Robinson's paper shows us such an understanding, such a general principle in actual operation, that it is of so great value. Here is no picture of what might be in a better world, but an actual portrait, drawn from the life, of a thing that is. The success of American labour methods is no longer in question. The most pronounced trades unionist cannot deny that the very benefits which he professed to seek by collective bargaining and the strike are being attained without his help. Individualism of labour is the rule of that country, but instead of resulting in the dire effects which trades unionists foresaw—and still foresee—it has had the opposite result. The men are prosperous and contented, and whilst each works professedly for his own hand the actual result is the improvement of the conditions of all—not only of the workmen themselves, but of the whole population of the country. "During the last twenty-five years," says Mr. Robinson, "the income of the United States has nearly doubled, whilst its population, though largely increased, has grown in a lesser ratio. The significance of these changes lies, not so much in the increase in the nation's production of wealth as a whole, as in the surplus purchasing power that has sprung from the increased output of the individual worker." That increase could not have been effected had not the workers refused to be bound by any agreement in restraint of output either by the limitation of the use of machines or by "ca-canny." Mr. Robinson tells us that in his country there is now 4½ horse-power at the service of every manufacturing wage earner. "On the conventional assumption that one horse-power is equal to the unassisted physical effort of ten men, the average capacity of the individual worker in the United States is more than forty times what it would be if unaided by mechanical energy." Unfortunately we have not similar figures for Great Britain, but they are not needed. It is common knowledge that the power used per individual in industry in most of the industries of this country is far lower than it might be with advantage. Now let us turn to the result as far as the workmen themselves are concerned. They are put succinctly by Mr. Robinson. "Earnings in twenty-three representative industries increased 115 per cent. between 1914 and 1925. Living costs of workers' families rose 68 per cent., and the hours of labour decreased more than 6 per cent. These figures indicate that wages in the manufacturing industry have more than kept pace with the increase in commodity prices. The surplus earning power thus represented well explains the present wide consumption of luxuries and the high standard of living that now exists." The American workman is, in fact, earning so much under conditions which make it possible for him to work to his full capacity that he has become a large investor in industrial securities. He is by that means securing by strictly constitutional and normal means that share in the control of the industries in which he is engaged which is sought for in this country without the obligations and responsibility of share holding. To quote Mr. Robinson once more—as one gives samples of a good thing—"To-day modern management stands not as the representative of capital alone, but as an entity representing the interests of the public, the stockholder, and the employee." All this has come about by means quite other than those which are dictated by the doctrines of trades unionism. No one will venture to say that it might have been foreseen. The principles of united action and collective bargaining appeared to be those logically fitted to secure the best conditions for Labour and to advance its interests. In America those principles have been defied and, manifestly, with success. "The composite American workman is of a high order of intelligence, peculiarly free from traditional bias and restraint, and welcomes, as a rule, mechanical assistance for the increasing of his output because of its greater attendant earnings. . . . He resents political and organised domination, and prefers his own negotiations to bargaining by representatives."

As we look back upon the long history of trades unionism we are forced to admit that there was a time when it was needed. The industrial era was in its beginning and the spirit of the age put capitalism in such an exalted position that it had rights almost over life and limb. But those days have passed by for ever. Public opinion which then tolerated, and even required them—for through the sufferings of the working people the richness of the country was made—is now as strongly opposed to them. Only here and there does an employer oppress his servants, and redress is always at hand for the sufferer if he invokes it. Taken by-and-large the desire of employers to see the welfare of their employees increased becomes every day more and more pronounced. The vices against which trade unionism fought no longer exist on a large scale, and the necessity for united action barely exists. Indeed it may be said that here, as in America, workpeople would be better paid were they perfectly free to express their own individuality. That there are many useful functions which trades unions can still perform we do not deny, but it is surely time that they

buried the past and put themselves into line with the new spirit that is ready to inspire manufacturing industries here, as it has already inspired those of America.

A Useful Line for Fuel Research.

Engineers are getting a little tired of being told of the iniquity of burning coal in its raw state, instead of first converting it into smokeless fuel, with oil, gas and ammonia as by-products. For this reason many may have failed to read more than the title of Professor Cobb's paper on "The Utilisation of Our Coal Supplies," presented to the British Association at the recent Leeds meeting. It would be a mistake, however, to pass over the paper in the belief that it is another of the wearisome arguments in favour of doing something, of which the desirability is as obvious as the commercial practicability is elusive. Professor Cobb certainly talks of low-temperature carbonisation, and mentions possible methods of overcoming the natural slowness of the process which makes the cost so formidable, but the real object of his paper seems to be to suggest that there are other avenues than low-temperature carbonisation which might be explored with advantage. In gasworks and coke ovens taken together something like 35 million tons of coal are turned into coke annually in Great Britain, or about 20 per cent. of the whole of the coal consumed in the country. Whether the coke produced be regarded as the primary or secondary product of a carbonisation process, and approximately equal quantities come under each of these headings, its value is largely dependent on its strength and homogeneity. Anything which seems likely to improve these qualities would be well worth investigation, and Professor Cobb suggests that the way may be found rather in the direction of modifying the chemical reactions which go to the making of coke, than in any changes in the mechanical or thermal treatment of the coal.

It would appear that the conversion of coal into coke, like many other chemical changes, is affected by the presence of catalysts, or substances which take no part in the reactions themselves, but in some obscure way provide the conditions under which the reactions can be accomplished. This point of view opens up prospects of "salting" the coal before it goes into the retort by the addition of a suitable catalyst, and thereby inducing a behaviour during carbonisation different from that shown by the same fuel when carbonised in its natural state. Laboratory experiments on these lines have given promise of success. It has been found that lime, oxide of iron and soda materially influence the process of carbonisation, the addition of 5 per cent. of either of these materials to the raw coal giving a much finer grained, more homogeneous and stronger coke. Unfortunately, as is often the case, the same results were not obtained when the process was tried on a large scale, possibly because the rate of heating was different. The special cokes then showed the same structure as cokes made in the ordinary way, being apparently neither better nor worse. But something had certainly happened in the retorts. From the coal treated with carbonate of soda, the gas yield, according to Professor Cobb, was increased by no less than 20 per cent., and when calcium carbonate was the catalyst the yield of ammonia was increased by 35 per cent. But the matter did not end here. The cokes, although having only the usual structure and mechanical qualities, had derived certain rather extraordinary properties from the catalysts, which became evident when they were used for making water gas or producer gas. Not only could they be gasified by steam, as in the water gas process, with enormously greater rapidity, but they also showed a power of reducing CO_2 to CO which may be of equally great importance to makers of producer gas. It is true that the experiments to which Professor Cobb referred as evidence of this behaviour were those of the laboratory, but they were so striking that it would seem worth while to have them repeated in ordinary commercial producers without delay. A few figures extracted from his paper will show the nature of the advantages which may be hoped for as a result of controlling coke manufacture by suitable catalysts. When ordinary coke maintained at a temperature of 1000 deg. Cent. was subjected to the action of steam, not more than 1·15 grammes could be gasified per hour in the laboratory apparatus, as with this rate of gasification the CO_2 in the gas produced reached what was considered the permissible limit of 5·2 per cent. With coke containing 5 per cent. of iron oxide, the rate of gasification could be increased to 10·5 grammes per hour, or over nine times as fast, with a CO_2 production of only 5·0 per cent. The behaviour of the coke made with 5 per cent. of soda was more striking still. Whereas the ordinary coke could only gasify one-quarter of its own weight of steam per hour, with a 5·2 per cent. production of CO_2 the soda-coke gasified more than double its own weight of steam with a production of only 0·4 per cent. of CO_2 in the resulting gases, and to bring the CO_2 up to 5 per cent. it was necessary to make the column of coke only one-quarter of its original length. The ability of the salted cokes to stand very high rates of gasification without producing excessive quantities of the wasteful and unwanted CO_2, would seem to depend largely on their power of reducing CO_2 when formed to carbon monoxide. At any rate, Professor Cobb's experiments showed that, whereas when CO_2 was blown through ordinary coke maintained at 1000 deg. Cent., the leaving gas only contained 47·8 per cent. of CO, the salted cokes gave CO ranging from 93 to 97 per cent. under exactly similar conditions. At a temperature of 900 deg. Cent. the proportion of CO produced from CO_2 by ordinary coke was only 14 per cent., as against from 63 to 82 per cent. with the salted cokes.

These figures would point to a notable increase in the rate at which gas producers could be worked if salted cokes were used as fuel, for whatever the kind of producer, it is the passing away of CO_2 with the gas which is the limiting factor. With an increase in the rate of gasification would come an automatic decrease in the size and cost of producers for a given duty, and possibly an application of producer gas to purposes from which it is now practically precluded. The propulsion of road vehicles is a case in point. But even if no new fields are opened to the gas producer, the latter already occupies a sufficiently important position in industry for the possibilities foreshadowed by Professor Cobb's paper to be of the highest practical interest. There may well be other catalysts as yet undiscovered which will produce even more striking modification in the behaviour of coke. None of those so far mentioned would seem unduly expensive, considering the increased gas and ammonia yields, as well as the properties imparted to the coke. Again, it would appear that any substance acting as a true catalyst should be recoverable for use again, if its value were sufficient to justify such a course. The range of substances of possible utility would thus be widened. How the catalysts referred to by Professor Cobb were added to the coal, he does not tell us, nor whether the effect produced was proportional in any way to the quantities used. There may be a useful field for investigation into all these matters, for it would seem doubtful that at so early a stage, the best catalysts, the best method of employing them and the most effective quantities, have yet been discovered. Coal research work, which seems to have been wandering off for some time into fields which interest the palæo-botanist, or the organic chemist, rather than the engineer, might well be directed along the path suggested by Professor Cobb's paper, for this at least shows promise of leading to some practical result. It may be that we shall have to wait till the action of catalysts generally is better understood before we know exactly how the presence of a little carbonate of soda will increase the gas yield from coal by 20 per cent., and produce a coke which can be turned into water gas at nine or ten times the rate of ordinary coke; but the immediate practical need is to find out how to do commercially what the laboratory shows to be possible.

An Industrial Peace Conference.

A conference of representative employers, labour leaders and officials of the Brotherhood Movement was held at the Mansion House on Monday, October 17th, under the chairmanship of the Lord Mayor of London, with the object of discussing how to obtain more peaceful relations in industry. There was a large attendance, although only a few of the acknowledged leaders on either side put in an appearance. Letters of regret were received from a large number of people, and it must be said that the employers were the more strongly represented of the two. Thus we had present Sir Alfred Mond, Sir Robert Hadfield, and Sir Hugo Hirst, all closely associated with engineering; whilst on the trade union side Mr. Tom Shaw and Mr. Ben Tillett were the chief speakers, following Mr. C. G. Ammon, also representing the labour side, who opened the debate. The main case from the employing side was put by Sir Alfred Mond.

Reviewing the conference as a whole—it lasted for 2½ hours—it cannot be said that it led to anything immediately practical nor that it produced any new facts or arguments. This, however, is not intended as a destructive criticism, because any effort towards establishing goodwill among all those concerned in industry is to be encouraged and assisted. It may indeed be found that the conference will have paved the way for constructive action in the near future. For the most part, however, the speeches were statements of fact, in language which has now become quite familiar, of the labour attitude towards the industrial position, followed by assurances on the part of employers that they fully sympathise with the aims and aspirations of labour and are willing to assist. All this, of course, has been said times without number ever since the establishment of the Whitley Councils, and the difficulty is now, as it has been all along, to find some means of finding a practical issue in these sentiments. The conference, as a conference, failed to carry us any further in this respect, except for one suggestion by Sir Alfred Mond, who urged the formation of a permanent Court of Arbitration to deal with all labour disputes immediately any suggestion of a dispute arises. Such a body, which he styled a League of Industry, it was not proposed should have any compulsory powers, but just as Sir Alfred believes that the League of Nations has been the greatest moral force we have ever had in the cause of international peace, so he believes that a League of Industry, whose function it should be to deal with all industrial quarrels, would have a similar moral force in maintaining peace in industry, and that its findings would be loyally accepted by both sides to a dispute under the stimulus of public opinion, because, coupled with the suggested formation of the League, was the demand for greater publicity so that the public should know the whole of the facts. This suggestion of Sir Alfred Mond's was backed up by Sir Robert Hadfield, who expressed surprise that more use had not been made of the Council of Arbitration established many years ago, which, he believed, still existed. On the other hand, Mr. Tom Shaw reminded Sir Alfred Mond that we had had such an organisation as had been suggested in the National Industrial Council, which the Government of the day, however, had scrapped. This was the one definite and practical fact which emerged from the conference at the moment, but with the evident desire on all sides that action should not cease with the closing of the conference it may be taken for granted that the matter will be followed up in some way.

Sir Alfred Mond's speech was an eminently statesmanlike one. He spoke with some scorn of the fact that in the year 1927 we should be talking of peace in industry, and he condemned everybody concerned—employers and labour alike—for incompetence in dealing with their affairs. The position of industry, he said, had been disturbed by the return to the gold standard, however it may have pleased the Treasury; but that apart, he deplored the manner in which the industrial field had been made a political battleground. We wanted, he said, no parties and no politics in industry, neither need we talk of employers and employed. Rather should we speak of co-operators and co-partners. That principle had been carried out in his own firm to such an extent that during an existence of more than fifty years there had not been a day lost through an industrial dispute. He recalled the scheme relating to those employed in the chemical combine, particulars of which were recently published, and added that that represented the attitude which the board of that concern adopted towards those who were employed by it. The great thing was for everybody to get together and make the profits before disputing how the profits were to be distributed. It was useless nowadays to discuss the merits or demerits of combines and so-called trusts, because combines were forced upon us by circumstances of which we were not masters. (Mr. Ammon, in his opening remarks had called attention to the possible dangers from the workers' point of view of the tendency of industries to combine.)

It was satisfactory to hear from the trade union side a demand that greater production should be aimed at as leading to higher wages, and at the same time it was urged that steps should be taken to deal with those firms whom it was alleged are at present restricting output and maintaining prices to the detriment of the workers. America was pointed to as having shown us that increased output and high wages go hand in hand, but we need not go so far afield for evidence of that kind. Quite recently the production manager of Morris Motors (1926), Ltd., showed in a striking manner how the average wages of Morris employees have gone up as the sales of cars have increased and the price to the public has decreased.

One thing was clearly demonstrated, and that was a distinctly broader outlook on the part of those trade union speakers who took part in the debate than has usually been associated with some of them. It was gratifying to hear them urge the introduction of more machinery and increased outputs, two features of industrial progress which for many years were anathema to certain of their colleagues. With all this comes the demand for a greater share on the part of labour in the management of industry, and Sir Alfred Mond humorously dealt with that point by remarking that with the better education of the masses the workman now often thought that the directors of the businesses in which they were engaged were not fit for their jobs.

The Transfer of Heat in Cylinder Walls.

No. II.*

The second of the series of lectures, arranged by the University of London, upon the subject of the transfer of heat in the cylinders of reciprocating engines, by Professor Dr.-Ing. Adolph Nägel, of Dresden, was given at the Institution of Civil Engineers on Friday, the 14th inst., Dr. W. B. Worthington (a Past-president of the Institution of Civil Engineers) in the chair.

Continuing from his first lecture, Professor Nägel mentioned other men who have investigated the subject of heat transmission between the working substance and the cylinder walls of the steam engine. He referred to the work of M. T. Nadal, the French engineer, who published his "Théorie Mathématique de la Machine à Vapeur, Action des Parois," in the "Annales des Mines," in 1897 and 1898. In his speculations Nadal assumed a cylinder perfectly insulated externally. He also considered, with other workers, the controversy at that time raging between Hirn and Zeuner as to whether the film of moisture on the inside of the wall causes the temperature difference between steam and wall. Nadal's two main deductions were :—

(*a*) The mean temperature of the wall surfaces in contact with the steam can only be equal to the mean temperature of the steam if the coefficient of heat transfer between steam and wall, and *vice versâ*, is constant during the complete cycle.

(*b*) As the tests of Donkin and Callendar and Nicolson proved, the mean temperature of the wall is substantially higher than that of the steam. Thus, the coefficient of heat transfer for the period in which the wall is heated by the steam, *i.e.*, during the "area of condensation," must be greater than for the period when the steam receives heat from the walls, i.e., when the film of moisture is re-evaporated.

Nadal gave the following values for this coefficient : —During condensation $\alpha = 48{,}600$ K. cal. per square metre per hour per degree Centigrade ; during re-evaporation $\alpha = 3600$. From the great difference between these values Nadal explained the action of the steam jacket. The advantage of jacketing, he held, consists in raising the mean wall temperature, so reducing the condensation loss. On the other hand, the low value of α during re-evaporation opposes an increase in the loss of jacket heat during exhaust, an increase which otherwise would nullify the advantage of jacketing during the admission period. Professr Nägel, while doubting the large difference between the values of α obtained by Nadal, considers his paper of great value.

The experiments of Duchesne, of Liége, published in the second volume of the "Revue de Mécanique," 1906, are similarly not conclusive. He used two types of thermo-couples—for the measurement of the instantaneous temperature of the steam, a network of platinum and silver wires, 0·028 mm. in diameter, welded together at the points of intersection, was used, and for the wall temperatures platinum and silver strips, 0·002 mm. thick, soldered together, and put periodically into contact with the walls gave the instantaneous readings required. In spite of elaborate arrangements, the readings of wall temperature were faulty, and, as a result, Duchesne obtained greater temperature fluctuations at the inner wall than those found by Callendar and Nicolson in corresponding tests.

His steam temperatures were reliable, since they agreed well with those found from the indicator diagram during the expansion of the saturated steam. The steam temperature reached at the end of compression was remarkable, being 275 deg. Cent. at a pressure of 5·7 atmospheres, *i.e.*, 81·5 lb. per square inch. Professor Nägel intends to refer again to this in his third lecture. Using the doubtful wall temperatures, Duchesne, by analysing an indicator diagram, obtained a value of $\alpha = 70{,}600$ for the admission period. This value decreases and, owing to the reversal of heat flow immediately after cut-off, reaches the very low value $\alpha = 1800$. On account of this, the steam would only deliver heat to the wall during admission, and would receive heat from the wall immediately after the beginning of expansion. In addition to the inaccurate readings of the wall temperatures, there is also the drawback that Duchesne measured this temperature at only one point, and supposed this to be the temperature existing at any instant on the whole area of wall in contact with the steam. Callendar and Nicolson had already shown that this temperature is definitely not uniform. Thus, Duchesne's values for the coefficient of heat transfer cannot be regarded as trustworthy.

Further tests were made by E. Heinrich at the Technische Hochschule in Stuttgart. He published accounts of his tests and their results in the *V.d.I. Zeitschrift* in 1912 and 1914, and also in the *V.d.I. Forschungshefte*, Nos. 146 and 183. Holes were drilled in the cylinder wall of the steam engine under consideration, to within 4·0 mm. of the inner wall, so that the mean temperature could be measured by means of a mercury thermometer or a thermo-couple. The engine, fitted with double-seated drop valves, was supplied with saturated steam at 8·2 atm. pressure absolute, *i.e.*, about 117 lb. per square inch. Heinrich attempted to calculate from hydrodynamical considerations the rate of flow of steam into the cylinder, and compares this rate with that obtained from an indicator diagram, the results of both calculations being plotted with the admission period as base. The points at which the two curves intersect mark, according to Heinrich, those points where the flow of heat from steam to wall begins and ends.

Heinrich neglected the phase difference between the temperature variations of steam and wall, and accepted, following Callendar and Nicolson, the assumption that the wall temperature vibrates sinusoidally about its mean value. The highest and lowest wall temperatures coincide in phase, therefore, with the steam temperature at the beginning and end of the periods of heat interchange. The temperature difference range found by Heinrich shows similarity with that of Callendar and Nicolson. He calculated the dryness fraction of the steam at cut-off, and, taking into account the total steam in the cylinder, found the quantity which, during admission, is condensed on the walls.

This condensation heat suggested to Heinrich a second way in which to calculate the heat-interchange equation, *i.e.*, by taking into account the temperature difference between steam and wall and the surface area at any time with different points of cut-off. Finally, he determined, from an indicator diagram, the quantity of heat transferred from steam to wall during admission. He found good agreement between these methods of calculation when α was taken as 49,000 K. cal. per square metre per degree Centigrade per hour, a result holding good, naturally, only during admission and with saturated steam.

Professor W. Nusselt, of Munich, formerly of Dresden, proposed a theory for the heat transfer between steam and walls which appeared in the *V.d.I. Zeitschrift* in 1916. He supposes that a film of moisture is formed on the wall, the temperature drop from steam to wall taking place through the film thickness. Thus, owing to the heat conducted through the film from the steam to the wall, steam will condense, at the temperature corresponding to the saturation pressure, on the outside of the film. The condensate built up runs away under gravity and leaves behind a film of thickness, constant at any point, which depends on the viscosity of the water, the form and inclination of the surface, and so on. In applying this theory to condensation taking place during admission in an actual engine the flowing away of the condensate under gravity may be neglected since the available time is too short for the effect to be measurable. Nusselt's original formula, with this modification, gives a very simple expression for the coefficient of heat transfer, viz., $\alpha = \frac{\lambda}{y}$, where λ is the coefficient of thermal conductivity of the water and of the momentary thickness of the film of moisture. Assuming that, at the point of admission, the wall is dry, *i.e.*, $y = 0$, and that at cut-off the film thickness is y_1, then the mean film thickness may be taken as $y_m = \frac{y_1}{2}$. In the Heinrich tests described we find $y_1 = 0{\cdot}0284$ mm. If the value $\lambda = 0{\cdot}705$ K. cal. per square metre per degree Centigrade through a thickness of 1·0 mm., per hour, determined by Professor Jacob, of Berlin, at a temperature of 160 deg. Cent., be taken, the mean value of $\alpha = \frac{\lambda}{y_m \times 10^{-3}} = \frac{0{\cdot}705}{0{\cdot}0142 \times 10^{-3}} = 50{,}000$, which agrees closely with the value found by other methods. In this, λ is a constant, while y increases from 0 to y_1, hence it follows that α is decreasing during admission, and that the above is a mean value for the whole admission period.

Nusselt derived another relationship from this speculation, that of the dryness fraction at the point of cut-off. This he found to depend upon the speed of running and upon the point of cut-off.

Although consistent values of α can be obtained by various methods when saturated steam is used, no explanation is as yet available of the process during the re-evaporation of the film of moisture. Further, the necessary knowledge concerning cooling of superheated steam in contact with the cylinder wall has still to be obtained. In connection with these matters the suggested theories are at variance and further reliable test data are required. In his next lecture Professor Nägel will indicate the extraordinary difficulty of these problems.

The following table shows the results obtained by the various workers referred to :—

Values of α.

Grashof, 1884 ; Kirsch, 1886		$\alpha = \infty$
Fliegner, 1897	Saturated steam ..	$\alpha = 414{,}000$
	Superheated steam ..	$\alpha = 41$
Callendar and Nicolson, 1898		$\alpha = 10{,}700$
Nadal, 1897–8	During condensation ..	$\alpha = 48{,}600$
	During re-evaporation	$\alpha = 3{,}600$
Duchesne, 1906	During condensation ..	$\alpha = 70{,}600$
	During re-evaporation	$\alpha = 1{,}800$
Heinrich, 1914	During condensation ..	$\alpha = 49{,}000$
Nusselt, 1916	During condensation ..	$\alpha = 50{,}000$

The values given in the above table do not indicate any clear and simple line of development of our knowledge of the subject.

In passing to the question of heat transfer in internal combustion engines, Professor Nägel pointed out that these were subjected to extensive tests at a much earlier stage of their development than steam engines. The first papers on the subject under consideration, written by Professor Aimé Witz, of Lille, came soon after the invention of the four-stroke cycle. They were "Essai sur l'Effet Thermique des Parois d'une Enceinte sur les Gaz qu' elle renferme," in the "Annales de Chimie et de Physique," 1878, and "Etudes sur les Moteurs à Gaz tournants," in the same publication in 1883. In the second Witz stressed the very important part played by the interchange of heat between gas and walls.

He had already pointed out, as a result of his numerous tests, that the coefficient of heat transfer became greater with an increase of the temperature difference and increased also directly with the density of the gas. The importance of the connection between the coefficient and the density was latter overlooked, the temperature difference only being investigated and accepted as the chief factor influencing the value of this coefficient.

Professor Eugen Meyer, of Berlin, while at the University of Göttingen, made extensive tests on a Deutz four-stroke engine and published the results in the *V.d.I. Forschungshefte*, Nos. 3 and 8. In calculating the heat flow from an indicator diagram he used the relationship $d\,Q = c.\,F.\,(T - T_w)^m \,.\, d\,z$, where Q is the heat quantity, c and m are constants, F is the area of the wall transmitting the heat, T, T_w are the temperatures of gas and wall respectively, z is the time. Then $\alpha = c\,(T - T_w)^{m-1}$ and is therefore dependent on $T - T_w$. Meyer tested the engine over the range from light to full load in order to obtain values for m and c. Assuming $m = 1$, giving $\alpha = c$, a constant, the value of the heat transferred to the walls was too small. He found the value of m to be 1·9, but used $m = 2$ to allow for heat losses. Thus $\alpha = 0{\cdot}148\,(T - T_w)$.

Arnold Langen, of Deutz, carried out his "closed vessel" explosion experiments at Dresden in 1902, his object being to find the specific heats of diatomic gases at high temperatures. See *V.d.I. Forschungsheft*, No. 8. Dr. Wach, of Hannover, used Langen's results to determine the value of α in closed vessel experiments. He found

$$\alpha = 0{\cdot}0878\ (T - T_w)^{1+[0{\cdot}001(T - T_w) - 1]^2 \,.\, 10^{-1}}$$

in which the increase of α with $(T - T_w)$ is still larger than stated above.

The lecturer referred at some length to the experiments of Sir Dugald Clerk, published in the "Proceedings" of the Royal Society in 1906, and said that Professor Nusselt, of Munich, in discussing Clerk's results, observes that, in addition to the main dependence of the heat transferred on the temperature, they prove also the influence of the density of the gas. This is the case, since all values of the heat transfer, the other conditions remaining constant, are less when the temperature of the cooling water is raised and the mean density of the gas referred to the same temperature difference is thereby lowered. Thus α increases substantially with increase of the temperature difference, and, in a less degree, with the density.

It has long been thought that radiation from the hot gases takes an important part in the transfer of heat. Langen, in discussing his tests, referred to it. The tests of W. T. David, published in the "Philosophical Transactions" of the Royal Society in 1912, were made at Cambridge at the suggestion of the late Professor Bertram Hopkinson, and were the first systematic investigations of gas radiation under conditions approaching those existing in the internal combustion engine. David concluded that the radiation increases as the fourth power of the absolute temperatures ; in addition, his observations show an increase with the density of the gas. In connection with the capacity for absorption of the burnt gases, he pointed out a decrease in the coefficient of absorption under increasing temperature and also a decrease due to increasing density.

Professor Nusselt, now of Munich, while at Dresden, carried out tests in this connection. His results were published in the *V.d.I. Zeitschrift* in 1914 and 1923 and also in the *V.d.I. Forschungshaft*, No. 264. In order to separate the heat received by the wall by radiation he made experimental use of the facts that this heat varies as the cube of the linear dimension of the containing vessel, while that received by conduction varies as the square of the linear dimension. He therefore carried out similar tests with the hollow vessels of different sizes, but geometrically similar, shown in Fig. 2. The diameters of these spherical vessels were 200 mm., 400 mm., and 600 mm. respectively, the intermediate size being intended to act as a check. A further variation of conditions was obtained by gilding and polishing the interior of the vessels in one series and by blackening over the gilding in a second series.

Calculations made from the first series brought disappointment, and really led to a change from the original plans. In the case of the gilded inner wall the radiation is, for the most part, reflected until it is absorbed by the gas charge. The results, therefore, when the gas charge was allowed to cool in the gilded vessel, should depend almost entirely upon the con-

* No. I. appeared October 14th.

duction of the heat. Contrary to expectation, a surprisingly large decrease of the coefficient of heat transfer resulted at the beginning of cooling, *i.e.*, after maximum temperature. Nusselt, in attempting to clear up this phenomenon, discovered that the cooling of a hot gas charge enclosed in a cold metal vessel first takes place in accordance with the facts that, in addition to the instantaneous temperature, composition, and density of the gas, the time interval from the beginning of cooling is also important. The smaller this interval the larger the coefficient of heat transfer.

This influence of time follows from the fact that the sudden contact of the hot gas charge with the cold wall modifies the temperature gradient in the charge, from outside towards the inside, as a result of the heat delivered to the wall. This influence is further increased, since the heat conduction within the gas

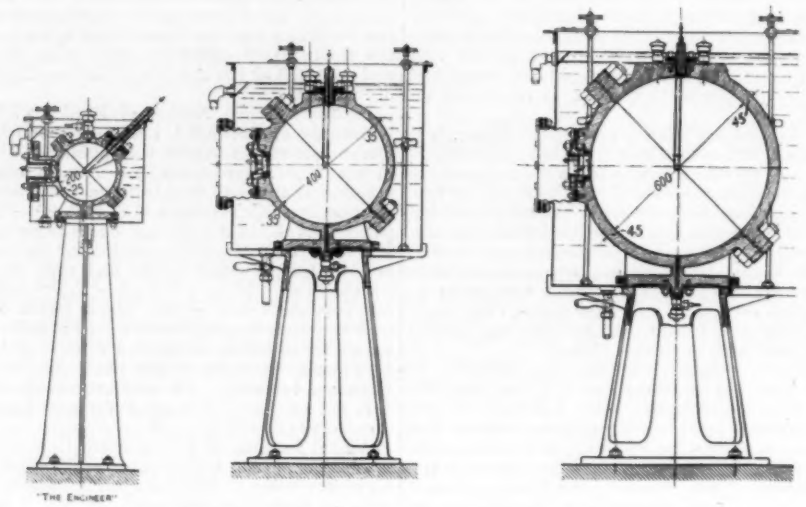


FIG. 2—NUSSELT'S "CLOSED VESSELS" FOR EXPLOSION EXPERIMENTS

after a certain interval produces a new temperature gradient. After this the coefficient of heat transfer is no longer dependent upon the time. Fig. 3 shows the range of values of the coefficient for four tests under similar conditions of gas composition and density, but for different explosion temperatures. The maximum temperatures in the four cases were 2114 deg., 2413 deg., 2796 deg. and 3141 deg. Cent. absolute respectively. Below 1800 deg. Cent. absolute all four curves coincide, showing the heat transfer to depend on the temperature. Nusselt therefore stated that the coefficient consists of two parts: one part, under constant density conditions, depends only on the temperature; the other, only on the time and called by him the "time factor." Unfortunately, it is difficult to calculate accurately the value of this time factor. He derived, from the laws of radiation,

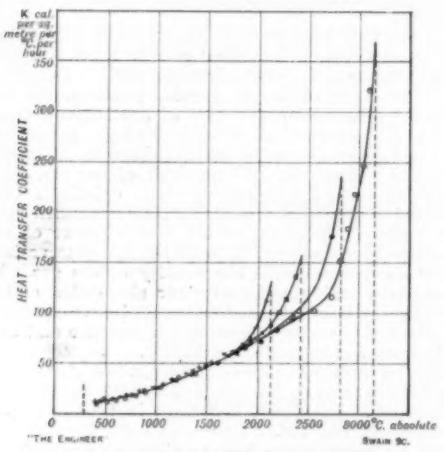


FIG. 3—EXPLOSION EXPERIMENT CURVES

the following formula giving the coefficient of heat transfer by radiation:—

$$\alpha_R = \frac{0{\cdot}362\left[\left(\frac{T}{100}\right)^4 - \left(\frac{T_w}{100}\right)^4\right]}{\left(\frac{1}{A_1} + \frac{1}{A_2} - 1\right)\left(T - T_w\right)}$$

K. cal. per square metre per deg. Cent. per hour, where T, T_w are the absolute temperatures and A_1 A_2 the absorptive capacity of gas and wall respectively. He calculated for his closed vessel experiments this coefficient α_R, subtracted it from the observed coefficient of the total heat transfer, and took the remainder as the coefficient of heat transfer by conduction α_c. These, with the time factor, are shown diagrammatically in Fig. 4. Thus he deduced the equation $\alpha_c = 0{\cdot}0178 \cdot T \cdot \gamma^{\frac{1}{3}}$ K. cal. per square metre per deg. Cent. per hour, where γ is the density of the gas. Eliminating γ, using the characteristic equation, the value for α_c now becomes

$$\alpha_c = 0{\cdot}99\ \sqrt[3]{p^2\ T}$$

where p is in metric atmospheres, a relationship holding good for the cooling of any quantity of a gas at constant volume.

To apply this formula to the internal combustion engine Nusselt derived an additional term to take into account the mean piston speed W. From other tests he received support for his formula, and concluded that the coefficient of heat transfer in internal combustion engines is $\alpha = 0{\cdot}99\ \sqrt[3]{p^2\ T}\ (1 + 0{\cdot}24\ W)$ in the same units as before.

Professor Neumann, of Hannover, in 1920, made careful tests upon a 50 B.H.P. M.A.N. Diesel engine at the Technische Hochschule at Dresden, which he published as *V.d.I. Forschungshaft*, No. 245. His values of heat quantities as found from the indicator diagrams are compared with those calculated by Nusselt from his formula in the following table:—

Tests of a Diesel Engine by Neumann.

Gas pressure, p atm.	Gas temperature, T° C. abs.	α in K. cal. per square metre per deg. Cent. per hour.			
		From Neumann	From Nusselt.		
			α_c.	α_R.	α.
33·8	843	531	515	4	519
33·6	905	455	555	5	560
35·0	1223	500	596	10	606
26·7	1595	662	544	19	563
14·5	1457	553	351	15	366
9·95	1352	262	266	14	280
6·80	1222	100	200	10	210
5·15	1136	—	162	8	170
4·30	1087	—	141	7	148
3·80	1060	—	129	7	136

The agreement is satisfactory; a further point that is remarkable is the small values of α compared with

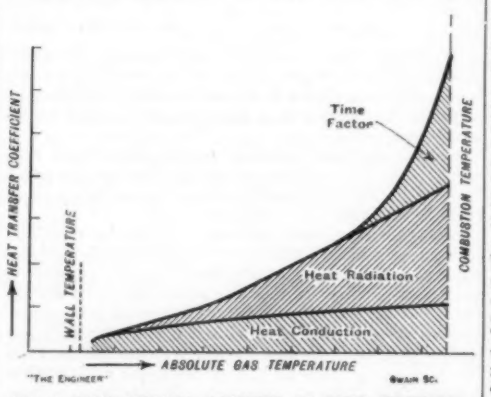


FIG. 4—DIAGRAMMATIC ANALYSIS OF HEAT TRANSFER

α_c. This agreement led Nusselt to assume that the influence of the time factor, which was considerable in the closed vessel experiments, was greatly overshadowed, in an engine cylinder, by turbulence. This is, of course, taken into account in his formula by the term involving velocity.

In order to check this term and, above all, to prove that the coefficient of heat transfer α increases according to a linear relationship with W, Nusselt applied to his formula the results of some tests at various speeds carried out by Professor Nägel upon a large four-cylinder, two-stroke Diesel engine built by Sulzer Brothers at Ludwigshafen. Nusselt computed, from his formula, the quantities of heat lost to the top of the piston and compared them with the lecturer's test results, as shown in the following table.

Professor Nägel next referred to some very comprehensive tests carried out in the M.A.N. shops at Augsburg. The mean temperatures at different points in the cylinder wall of a double-acting two-stroke Diesel engine were found to depend on the mean effective pressure. The highest temperature recorded at normal load as 265 deg. Cent. was at the inside of the cover. The temperature at the inside of the water-cooled ribs of the exhaust ports was always less than 100 deg. Cent., so that uncooled ribs are possible in future designs. The heat transferred to the piston was from 350 to 190 K. cal. per B.H.P. per hour as the mean effective pressure varied from 1·5 to 5·0 atmospheres, *i.e.*, from about 21 lb. to 72 lb. per square inch; the total heat delivered to the cooling water over the same range of loading is from 960 to 600 K. cal. per B.H.P. per hour. Thus about one-third of the heat received by the cooling water passes through the piston. The percentages of the total heat transferred to the various cooled parts at the upper load are approximately: piston, 35; liner, 35; scavenging pump, 8; lower cover, 8; upper cover, 8; middle wall, 6.

Heat Lost to the Pistons of a Sulzer Two-stroke Marine Diesel Engine.

Revs. per min.	Indicated horse-power.	Piston heat, K. cal. per hour.	
		Calculated.	Observed.
92·7	2,488	248,000	244,000
85·6	1,995	190,000	203,000
77·4	1,518	171,000	157,000
67·6	1,080	136,000	120,000
54·6	626	89,200	88,000
43·2	366	49,000	37,600
99·9	2,295	223,000	225,000
85·7	1,139	139,000	142,000
54·0	1,249	158,000	174,000

In concluding, Professor Nägel mentioned some tests he made recently upon an opposed-piston Diesel engine at the Junker's works in Dessau. The cylinder diameter was 160 mm., the strokes of the upper and lower pistons 240 mm. and 320 mm. respectively. At the normal speed, 160 r.p.m., the engine developed 60 B.H.P. with a brake M.E.P. of 6·3 atmospheres, *i.e.*, 90 lb. per square inch. Sixty-four thermo-couples were placed at different points along and around the liner. Half of these thermo-couples were 3·2 mm. distant from the inner wall, the other half at a distance of 15·0 mm. from the inner wall, or about 3·0 mm. from the outer wall of the liner. The object of the tests was to find the rate of heat transmission of the different zones of the cylinder liner. In the combustion zone, *i.e.*, between the pistons when at inner dead centres, the temperature reached nearly 200 deg. Cent.

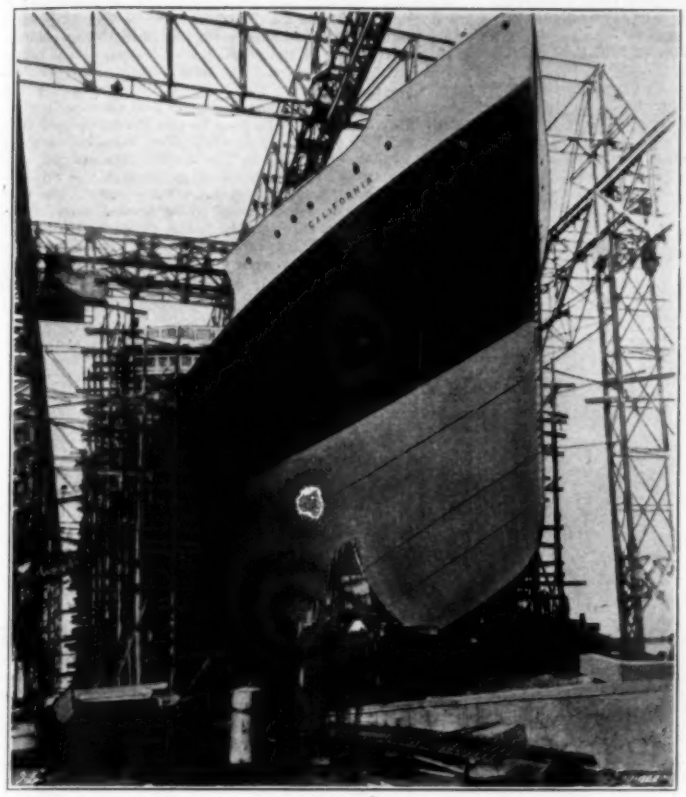
In the last two lectures Professor Nägel intends to describe the tests he has made upon a Uniflow steam engine and also some tests by Dr. Eichelberg upon a Diesel engine. The temperature was measured with improved apparatus and the test results are of especial interest.

SIXTY YEARS AGO.

To-day it is difficult to conceive how we could live as we do without our supplies of meat, fish, fruit and other edibles brought to us from overseas in a preserved state, and preserved after arrival in this country until required for consumption. Sixty years ago the problem of preserving meat so as to present it as an agreeable food had not been solved. The best that could be done was to preserve the meat, such as Australian boiled beef, in small hermetically-sealed cases containing 3½ lb. to 7 lb., or to reduce it to the form of concentrated extract or pemmican. The conveyance of fresh meat under refrigerated conditions, a development which has now reached enormous proportions and upon which vast numbers of the populace are dependent for their supplies, was just being thought of as a practical possibility. An early instance of the application of the system was mentioned in our issue of October 18th, 1867. The Lyman Refrigerating Transportation Company had, we recorded, been formed in America for the purpose of bringing fresh meat to New York from Ohio, Indiana, and other Western States. The journey would occupy from two to four days, and would be made through a country possessing a naturally high temperature. To preserve the meat during transit the company had produced a design of meat wagon capable of holding the edible portions of six oxen and 122 sheep. The wagon looked externally like an ordinary luggage wagon. Its sides were, however, double, with a 3in. thickness of cork between them. In the roof there were two openings through which large blocks of ice were inserted to rest on false bottoms perforated to allow water to escape. A ventilator in the middle of the roof drew in air as the train moved. This air cooled by the ice was distributed throughout the wagon by means of pipes. The temperature maintained within this wagon was stated to be about 19½ deg. Fah., a misprint possibly for 39½ deg. or even 49½ deg. Fah. . . . Another indispensable factor in our modern home life is the sewing machine. It is therefore of interest to note that in the same issue we reported the death of one whom we described as its inventor, Mr. Elias Howe, junior, of Bridgeport, Connecticut. He was born in 1819 at Spencer, Massachusetts, and at the age of sixteen went to work at a machinery factory in Lowell. A year later he found himself adrift as a result of the closing of the works. Subsequently he was engaged at an establishment at Cambridge, from which he migrated to Boston, where he worked in the shop of Ari Davis. It was while in this employment that he first thought of the sewing machine. In April, 1845, he sewed his first seam, and in May of that year he completed his work.

THE TURBO-ELECTRIC LINER CALIFORNIA

THE NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY, VIRGINIA, BUILDERS



The Development of the Extra-High-Pressure Locomotive.

During the last three years the Swiss Locomotive and Machine Works, of Winterthur, have been making an intensive study of the locomotive, with a view to improving its performance by the adoption of steam pressures and temperatures far in excess of those hitherto considered practicable in locomotive work. Calculations showed that the fuel economy to be gained would be very considerable, and the problem was to generate and utilise steam at very high pressure without departing from the reliability and simplicity which are so essential in a locomotive. For pressures such as those in view, namely, 700 lb. to 850 lb. per square inch, it was evident that both the boiler and engine would have to be designed on lines quite different from those of the ordinary locomotive, although naturally both would have to conform to the same conditions of operation. The long experience of the company in building locomotives of all kinds has enabled a very promising solution to be arrived at, and in a month or so the new machine should be in service on the road.

The boiler is of an entirely novel type. Water tubes, of course, are used. As soon as the boiler was built, in October, 1926, it was subjected to a series of shop trials, which continued for many months, in order that the most exact data could be obtained of its performance at all loads. The results were very good, indeed they surpassed all estimates. As soon as it was seen that the boiler was going to be a success the construction of the engine was begun. It works on the uniflow principle with inlet valves of the poppet type. It and its exhaust is used in a blast pipe in the ordinary way. Power is transmitted from it by gearing to a jack shaft, from which the driving wheels are actuated by coupling rods. The engine has passed very severe shop tests satisfactorily. If the efficiency which has been obtained on stationary tests is maintained under running conditions, the locomotive will show a very considerable saving in fuel and water over existing types. Mechanically it is much simpler than the ordinary steam locomotive with its complex valve gear exposed to dust and dirt, and the results of its performance on the road will be watched by all locomotive engineers with the greatest interest. As soon as the trials are complete we hope to publish a full description of this noteworthy machine.

Electrically-propelled Passenger and Cargo Liner California.

In our issue of September 9th we gave some particulars of the 22,000-ton liner California which will be propelled by turbo-electric machinery and is claimed to be the largest commercial vessel yet constructed in America and the largest of her type built in the world. She was launched on October 1st and is now being fitted out at the yards of the Newport News Shipbuilding and Dry Dock Company, Virginia, U.S.A. We have already illustrated the main propelling motors, but in what follows further details of the propelling and auxiliary machinery are given.

The California is being built for the Panama Pacific Line, a subsidiary of the International Mercantile Marine Company, of New Jersey, for use in intercoastal trade on a 5500-mile run between New York and San Francisco *viâ* Havana and the Panama Canal.

Delivery to the owners is expected to take place in January. Meanwhile contracts have been let for a second ship, practically identical with the California, to be constructed by the same builders at the same yard, and still another vessel of the same type is contemplated. The new liner has an overall length of 601ft. 3in., with a beam of 80ft. Her propelling machinery, which has been designed and built by the General Electric Company, of Schenectady, N.Y., is, in type, generally similar to that which has successfully been installed by the same builders in the battleships of the United States Navy. With propelling motors coupled direct to the twin screws, full power astern is available without the use of reversing turbines, and, as shown by our illustration Fig. 1, the reversing and manœuvring controls are very simple and only require four levers to be operated by the engineer on watch, the synchronous control of the turbine speed being automatic. For normal operation at a designed speed of 18 knots the full power of the propelling motors is rated at 13,500 S.H.P., but they have a maximum continuous rating of 17,000 S.H.P., which can be used when extra power is required for keeping time from port to port. Both motors can be also operated with the current supplied from a single generator when running at three-quarters of its rated output, and with one generator unit entirely shut down it is still possible to operate the ship with the remaining unit at 70 per cent. of her designed speed.

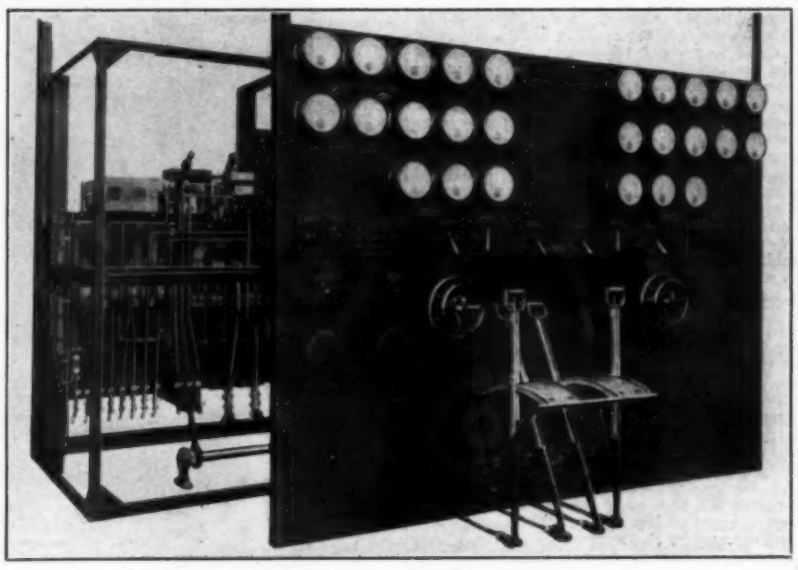


FIG. 1—STARTING AND MANŒUVRING CONTROL PANELS

Propelling Machinery.—The two half-tone engravings above show bow and stern views of the ship on the slipway shortly before she was launched. She has a cruiser stern and her form is very full, which, together with a beam of 80ft., gives an unusually large space for the propelling and auxiliary machinery. The three-bladed propellers may be noted; they have a diameter of 18ft. with a pitch of 17·9ft., and each blade is bolted to the boss with nine 4in. studs. The driving motor and the generating plant are at different deck levels and aft of the generator room is the refrigerating room, in which CO_2 plant is installed to meet the provision requirements of 12,000 cubic feet and to deal with 60,000 cubic feet of cool air space for fruit carrying and 40,000 cubic feet of frozen cargo space. Steam will be raised in twelve Babcock and Wilcox water-tube boilers, each with double-front furnaces, equipped with Peabody oil burners and arranged to work under forced draught. The boilers have a total heating surface of 55,176 square feet and about 16,000 square feet of superheater surface, and are designed for a pressure of 275 lb. gauge and a superheat of 120 deg. Fah. The main generator units comprise two General Electric marine-type steam turbines each rated at 6750 S.H.P. when running at 2640 r.p.m., which corresponds to a propeller speed of 110 r.p.m. At 2880 r.p.m. the two turbines are designed to develop 8500 S.H.P. each, corresponding to a propeller speed of 120 r.p.m. The main condensers, which are attached to the turbines, are reported to be the largest ever installed in an American-built ship. Each of them has a cooling rsuface of 11,000 square feet with 5300, ¾in. tubes, while the two auxiliary condensers each have 2800 square feet of surface and 1644 tubes. The main condensers each weigh 80,000 lb. empty and each have a capacity of 16,000 lb. of water, while the auxiliary condensers each weigh 20,000 lb. empty and each carry 4000 lb. of water.

The three-phase alternators, which are direct coupled to the main turbines, each have a normal rated output of 5250 kW at 2640 r.p.m. and 3700 volts, and a maximum continuous rating of 6000 kW, 4000 volts. The two main propulsion motors, which, it will be recalled, were illustrated in THE ENGINEER of September 9th, are of the three-phase synchronous induction type. Each of them has a designed normal rating of 5250 kW, or 6750 S.H.P., at 110 r.p.m. and 3700 volts, with a maximum continuous rating of 6000 kW, 8500 S.H.P. at 120 r.p.m. They are ventilated by four direct-current motor-driven exhaust fans which are automatically controlled from the starting panel. Each fan delivers when in normal operation about 20,000 cubic feet of ventilating air per minute.

The starting and manœuvring control panels are shown

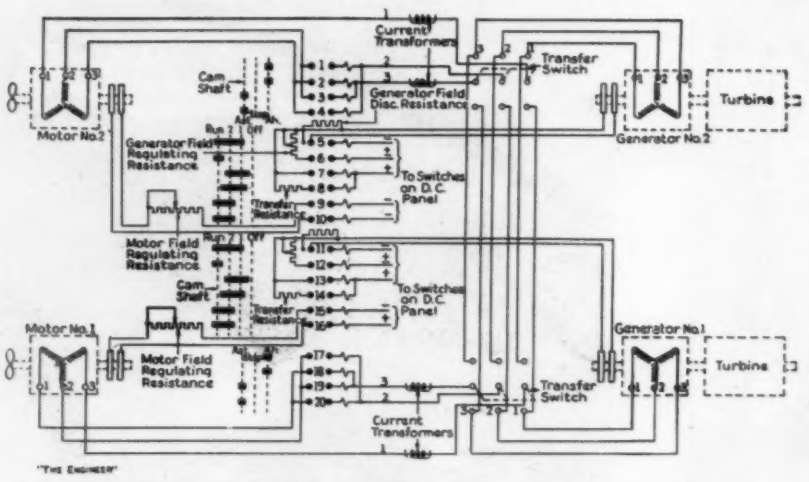


FIG. 2—CONNECTIONS FOR THE ELECTRICALLY-PROPELLED LINER CALIFORNIA

in Fig. 1. They consist of two panels, one for the main high-voltage controls and the other for the low-voltage controls of the field circuits. In between the panels are arranged the four levers which operate the reversing and field controls through rods, while on either side of the levers are the hand wheels for the field rheostats of the main generators and propulsion motors. Behind the front panel are grouped two sets of switchgear embracing the field and cut-out switches for the generators and separate control groups which are worked by the levers and rods already referred to. One of the control groups of switchgear will be seen to the left of Fig. 1. Each group is enclosed in a protective screen of expanded metal arranged on removable frames. On the main panel are the ammeters for the generator, propelling motor and ventilating fan circuits, and also the steam gauges, vacuum gauges, revolution counters, and temperature testing panels. The general scheme of the electrical connections is indicated in the drawing, Fig. 2.

Auxiliary Generator Plant.—Power for the refrigeration plant, pumps, elevators and all other ships' auxiliaries, including lighting, is supplied by four 500-kW turbine-driven generators which will furnish direct current for this purpose and also for exciting the propulsion motors. A large switchboard for the auxiliary power and lighting circuits is placed in the engine-room. It is 28ft. 6in. long and is made up of four generator panels, one three-wire balancer panel and seven distribution panels. There is also an emergency switchboard for stand-by lighting and some motor power as a reserve in case of failure of power in the engine-room. It serves to distribute the power from two small stand-by petrol engine-driven generators, which are arranged on one of the upper decks well above the water line.

The main switchboard has forty-three power circuits, thirteen lighting circuits, four propulsion excitation circuits and several additional spare circuits for future use. The four 500-kW direct-current generators are connected to the switchboard circuits through selective switches which are so mechanically interlocked that at any time only one of the generators can be used for propulsion excitation. The remaining three generators can be operated singly or two or three in parallel for auxiliary power and for lighting. Most of the auxiliary motors are so connected that they can be connected either to the excitation bus or to the auxiliary power bus. All auxiliary motors operate at 230 volts. The lighting circuit is arranged for a pressure of 115–230 volts on the three-wire system. The propulsion excitation circuit is arranged for a pressure of 115 volts with provision for using 230 volts on the propulsion generators during short periods while manœuvring. For normal sea service operation two 500-kW generators will be used in the daytime, and one during the quiet hours of the night. Three generators will probably take care of the ship under overload conditions, leaving one generator for use as a spare or stand-by set.

Engine-room and Deck Auxiliary Machinery.—Nearly all the pumping machinery in the main engine-room and refrigerating room is of the centrifugal type, and is electrically driven by G.E.C. motors. The same kind of drive is used for the four forced draught fans for the boilers, each of which is designed to deliver 28,000 cubic feet of air at 2½in. pressure. There are also over twenty-eight ventilating fans for the hull and passenger accommodation. The four refrigerating machines are of the Brunswick-Kroeschell CO_2 type, and are driven by 100 B.H.P. variable-speed motors. Special interest attaches to the rudder and steering gear. The rudder is of the balanced type and, together with its stock, it weighs 45 tons. A larger surface than usual has been provided, so that a margin of steering safety is given at the low speeds used when passing through the Panama Canal. In type, the rudder resembles that of the Majestic, and it has a rudder post diameter of 23in., with 13½in. diameter pintles. The variable stroke pump for the steering gear was supplied by the Waterbury Tool Company, and is driven by two 750 B.H.P., 400 r.p.m., 230-volt, direct-current motors. The pump delivers fluid to the cylinders and plungers of the Hyde Windlass Company's steering gear. Controls are fitted in the pilot house and the motors can be stopped either from the engine-room or the steering motor room. The warping capstans are also of the Hyde Windlass type, and are designed for a pull of 25,000 lb. at 50ft. per minute, or 2500 lb. at 125ft. per minute without changing gear.

Special attention has been given to the cargo-handling equipment to meet the special requirements of the intercoastal trade. In the side of the hull below the main deck are eighteen cargo ports, each 7ft. 4in. high by 8ft. wide. These will be used for handling both package cargo and motor cars. There are also four ports for stores, and two large passenger ports on D deck, communicating with the reception hall outside the main dining saloon, making a total of twenty-four ports. The deck cargo-handling gear is as follows:—On A and B decks there are eighteen reversible, single-drum, electrically driven, spur-geared winches, arranged in groups, and each winch is capable of handling 3000 lb. at 300ft. per minute. Warping heads are fitted on the outboard side of the outboard winch of each group, for use when handling the lifting booms. There are twelve booms, including one 10-ton and five 6-ton booms on the fore mast and six 6-ton booms on the main mast. On E deck there are also thirteen cargo winches. The boat equipment comprises twenty-two metal boats, nested in pairs, in Welin type davits with electrically operated boat-lowering or raising gear. Two of these are motor boats and two have masts and sails. There are electric lifts for passenger and cargo service and a lift from the engine-room to the engineers' quarters on the boat deck. From the foregoing it will be seen that the ship, as regards her auxiliary machinery, is equipped in the most modern way, and her performance at the beginning of next year will be awaited with unusual interest. We would express our indebtedness to the International General Electric Company, of Schenectady, N.Y., in placing these particulars at our disposal.

THE new Technical College at Chesterfield was opened by Viscount Chelmsford on October 12th.

Combined Air Heater and Economiser.

WE have recently had an opportunity of inspecting a novel appliance called a "Supermiser"—a combination of economiser and air heater—for use with steam boilers. It is the invention of Mr. A. E. Leek, Wigan, and is being introduced by Galloways, Ltd., Manchester. The "Supermiser" is designed for the purpose of abstracting the maximum quantity of heat from the flue gases of boilers before they are allowed to pass to the chimney, and thus increasing the overall efficiency. The essential feature of the appliance consists in the employment of pairs of concentric tubes, the gases passing through the annular space between the inner and outer tubes, while the feed water and the air which have to be heated pass in the opposite direction through the inner tubes and over the outer surface of the gas tubes respectively. In this manner the hot flue gases part with their heat to the water and to the air simultaneously. As the speeds of flow are high

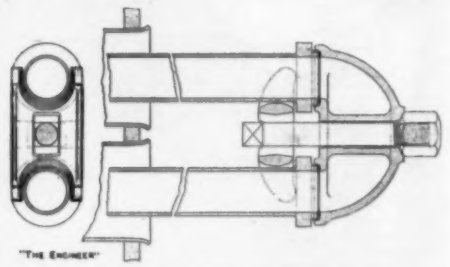


FIG. 1—SECTION THROUGH HEADER

the rates of heat transmission are correspondingly high, and the heating surfaces are therefore comparatively small.

A general view of the "Supermiser" installation attached to one of a battery of Lancashire boilers is given opposite. Fig. 3 shows a sectional elevation and transverse section of the apparatus, and Fig. 1 is a sectional view of one of the headers. From these illustrations it will be seen that the apparatus is very compact. The gas tubes are supported between two tube plates in a horizontal steel shell, being expanded into the tube plate at one end and a close fit in the holes in the tube plate at the other end, thus providing for expansion and contraction of the tubes caused by differences in temperature. The feed water tubes are supported inside the gas tubes longitudinally by thin radial fins, which offer the minimum resistance to the flow of gases. The tubes are connected in series by headers which have removable caps and can be quickly detached from the tubes. This arrangement provides easy access for inspection and cleaning, or for the removal of the tubes when required, the headers being accessible by the doors in the end boxes. A horizontal division plate is provided about the centre of the "Supermiser," extending from the tube plate at the front end for the greater portion of the length of the air chamber, so that the incoming air has to traverse practically the whole length of one half of the tubes before it returns along the surfaces of the upper group, thus absorbing the maximum possible amount of heat. The direction of travel of the air, gases, and water are shown by means of arrows in Fig. 3.

The design and details appear to have been carefully thought out. It will be noted, for instance, that sudden changes of section of the gas path have been avoided. In this way dead pockets where dust and soot can accumulate are obviated. It is for this reason, too, that curved baffles are fitted in the end boxes to guide the flow of the gases. At the front end a large door gives access to the end box. The baffles are removable, leaving the headers and tubes exposed for cleaning. The headers—Fig. 1—are malleable castings secured by a central bolt

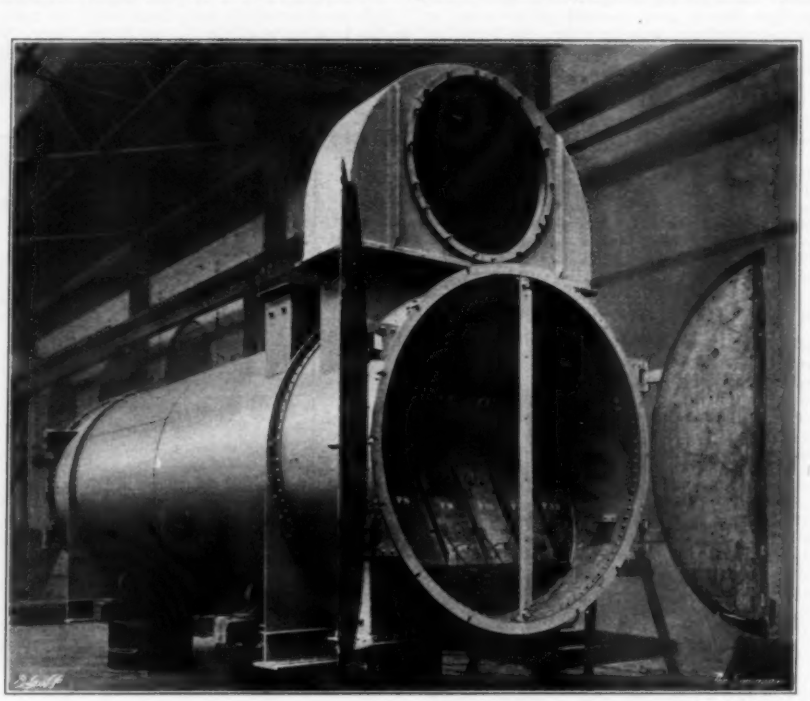
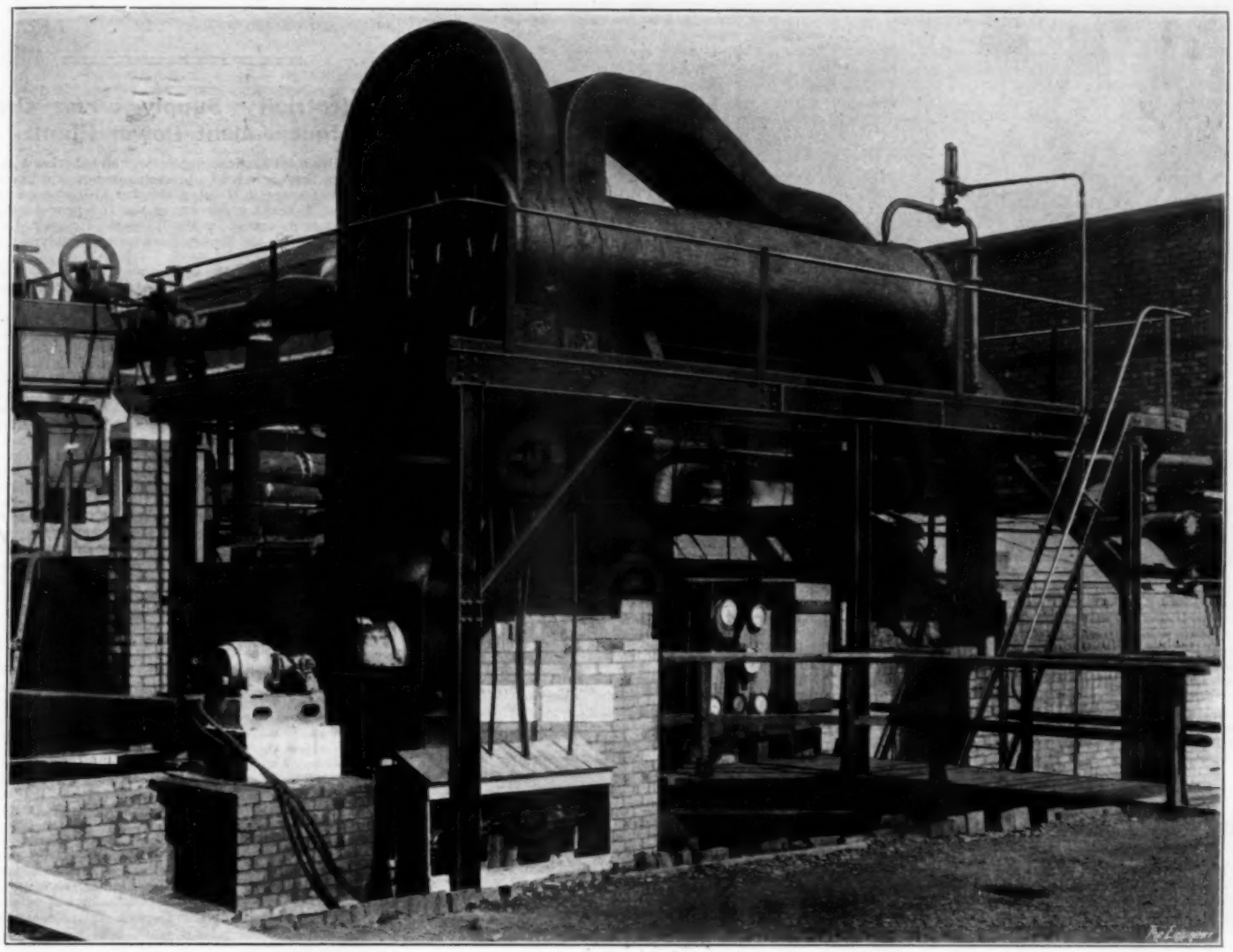


FIG. 2—END VIEW OF 8ft. 6in. DIAMETER "SUPERMISER"

COMBINED AIR HEATER AND ECONOMISER FITTED TO A LANCASHIRE BOILER

GALLOWAYS LIMITED, MANCHESTER, ENGINEERS



and nut to a bridge piece which abuts against collars on the water tubes.

The necessary velocity of the gases and air is imparted by means of fans. The gas fan is placed near the outlet, producing a suction and delivering the gas to the main flue through which it passes to the chimney. The other fan takes air from the atmosphere and delivers it under pressure to the "Supermiser," where, after being raised in temperature, it leaves, still at a slight pressure, and passes through an insulated sheet metal duct to the boiler furnaces, both above and below the fire-bars. The pressure through the apparatus it was 280 deg. Fah., while the temperature of the flue gases at the outlet from the boiler flue was 700 deg. Fah. and about 230 deg. Fah. in the duct between the "Supermiser" and the chimney. The corresponding temperatures of the water were 140 deg. Fah. on admission and 250 deg. Fah. at the outlet. The air and gas fans in this installation are driven direct by electric motors and the total brake horse-power, assuming 80 per cent. efficiency, is given as 11·2. On a 120 hours' test carried out by the makers on this plant recently the feed water evaporated per hour was 7842 lb. and the efficiency

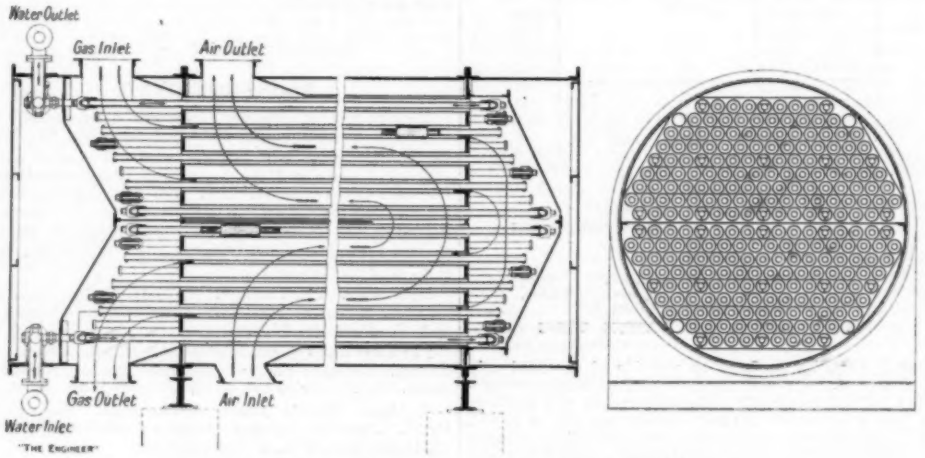


FIG. 3—SECTION THROUGH 3 ft. 10 in. DIAMETER "SUPERMISER"

can be regulated by dampers at the boiler front so that the pressure above the grate is slightly below that of the atmosphere and the fire doors can be opened for firing purposes without risk of injury to the stoker.

The "Supermiser" illustrated above has been at work for about twelve months at a colliery in Lancashire, where it is giving very satisfactory results. It is working in conjunction with a Lancashire boiler, 9ft. by 30ft., provided with a superheater and a mechanical stoker of the sprinkler type. On the occasion of our visit the temperature of the air was 54 deg. Fah. and after passing

of the plant was 81·4 per cent. After allowing 11·4 kW for driving the fans and 13 lb. of steam per kilowatt-hour the total consumption of the fans equals 148 lb. per hour, leaving a net overall evaporation of 7694 lb. per hour and an efficiency of 79·6 per cent. The apparatus illustrated is 3ft. 10in. diameter by 15ft. long inside the lagging. It has sixty-six concentric tubes and the air heating surface is 1140 square feet, while the water heating surface is 604 square feet.

The possibility of corrosion of the tubes due to deposition of moisture seems to be negligible owing to the high velocity and comparatively high temperatures of the gases. As a precaution, however, the lower air tubes, where the gas temperature is least, are made of non-corrodible steel and similar material is used for the water tubes. It will be observed that no brickwork setting is required.

We are informed that as the result of the economy effected by the use of this appliance other boilers belonging to the same colliery are about to be similarly equipped.

Messrs. Galloways have since constructed two "Supermisers" of similar construction to the above, 26ft. long by 8ft. 6in. diameter, for use in conjunction with a battery of Lancashire boilers with a total steam generation of 100,000 lb. per hour. The boilers are fired with blast-furnace gas and the guaranteed efficiency of the boiler batteries with the "Supermisers" in action is 80 per cent. A view of one of these "Supermisers" is given in Fig. 2.

B.E.S.A. SPECIFICATIONS.

TUBULAR TRAMWAY POLES.

A specification for wrought steel tubular tramway poles, which is a revision of the original specification issued in 1904 by the B.E.S.A. has just been published. The first specification was very extensively used, both at home and in the Colonies, and it was found that very little modification was required to bring it into line with modern requirements. An additional size has been introduced, the poles now being classified as light, medium, heavy and extra-heavy. Taper poles are no longer recognised as standard, but sectional poles (made in three separate sections swaged together) and one-piece poles (stepped in two parallel sections) are included in the specification, the lengths, outside diameters and minimum thicknesses being specified for each class, the overall length of pole in all classes being 31ft. Various mechanical tests are provided, and an appendix to the specification gives the approximate weights of poles.

ORDINARY SIZE BAYONET LAMP HOLDERS.

The long-awaited revision of the British standard specification for ordinary size bayonet lamp holders for voltages not exceeding 260 volts, has just been published. Owing to the recent introduction of moulded materials in the construction of lamp holders, it was considered by the Committee that until certain research work now in progress was completed, it was preferable to exclude materials from the specification. The specification therefore deals only with dimensions, these conforming to the interna-

STEAM GULLY EMPTIER

JOHN FOWLER AND CO. (LEEDS), LTD., ENGINEERS

tional standard as laid down by the International Electrotechnical Commission in so far as interchangeability is concerned. The specification gives standard details of the screw threads, shade carrier ring, union ring, plungers and terminals, and includes a detailed drawing of a standard lamp holder. The dimensions of the ordinary size bayonet lamp cap are also given for reference purposes.

These specifications may be obtained from the publications department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

The Fowler Steam Gully Emptier.

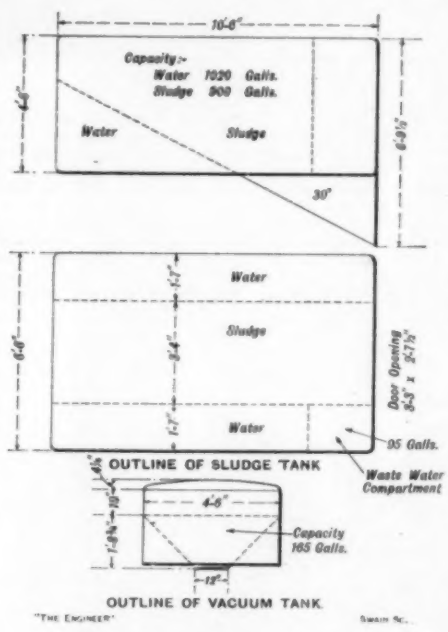
The common method of hand emptying street gullies by means of long spoon-shaped ladles is both crude and slow. Even in pre-war times, when the wages paid for this class of labour were low, the method was expensive on account of the time taken. At present, when the remuneration for this class of labour has increased to a great extent, the cost is quite prohibitive, and public authorities are wisely on the look-out for mechancal means of emptying street gullies. As the question of cost must be considered as well as efficiency, it is obvious that machines for the purpose should be capable of employment to the maximum extent in order to compensate for the interest on the capital outlay. The machine made by John Fowler and Co. (Leeds), Ltd., an illustration of which is given herewith, besides being capable of emptying gullies in a very short space of time, can also be used for street washing and sprinkling, thereby taking the place of the ordinary water carts.

The machine comprises Messrs. Fowler's standard steam wagon chassis on which are carried large tanks to contain the water for flushing and sprinkling and to hold the sludge which is extracted from the gullies. The boiler is of the vertical fire-tube pattern, giving a large heating surface by means of a number of curved tubes. It is built entirely without stays and the fire-box, pressed out of one plate, and the smoke-box tube plate are self-supporting under pressure. To eliminate priming a bulbous extension round the top of the boiler is provided to give a large water-line area. For inspection purposes the upper portion of the boiler shell comprising the water and steam spaces can be quickly removed. The boiler is built for a working pressure of 225 lb. per square inch. The engine is of the compound vertical V type with pistons working on a single crank and piston valves. It can be converted temporarily into a double high-pressure engine when desired by a by-pass valve from the high to the low-pressure cylinder. The crank chamber is extended to form a gear-box containing three sets of gears similar to those of a petrol-driven machine. From this gear-box power is transmitted to a live rear axle through the medium of a propeller shaft and worm gearing. All the working parts are well lubricated by means of an oil bath, except the cylinders, which have a mechanical lubricator. The cylinders are 4¾in. and 7½in. in diameter by 8in. stroke. The driver's cab is roomy and all the controls are easy of access.

The main tank is carried on the chassis. This tank has a central portion for the sludge, and the clean water tank extends along each side and under the front end of the sludge tank, as shown in the sketch. There is also an independent chamber separated from the water tank on the near side, into which liquid from the sludge tank can overflow through a perforated partition. This is a neat arrangement to increase the amount of sludge or solid matter which can be accommodated before it is necessary to resort to the tip or discharging place. The vacuum tank, which can be seen on top of the main tank, is exhausted by means of a steam ejector. A vacuum sufficient for the purpose can be created in this tank in about thirty seconds, and after each operation of emptying a gully the vacuum can be re-created while the machine is travelling from one gully to another. The contents of the vacuum tank are transferred to the main sludge tank by the opening of an air-tight door operated by a lever in the driver's cab, and the gully refuse is discharged through a large door at the rear, the operator standing quite clear while opening the door. The steep angle at which the bottom of the sludge tank is set renders the tank self-emptying.

The suction pipe for emptying the gullies is 4½in. diameter and, being completely balanced, can easily be swung into the desired position by hand. When it has been dropped into a gully the attendant has merely to open a valve and instantly the contents of the gully are emptied. He then closes the valve, replaces the pipe and re-seals the trap by a flush of water from another adjacent pipe fitted with a simple valve.

For street washing and sprinkling water from the tank is supplied under a pressure up to 20 lb. per square inch by means of an independent pump. When sprinkling the width of the spray and the amount of the water discharged can be controlled by means of levers, and the



WATER, SLUDGE, AND VACUUM TANKS

sprinkling can be confined to one side of the road only when desired. For washing purposes four nozzles are provided, all independently adjustable, while the angle of the jets in relation to the road surface can also be varied. An additional nozzle is fitted for gutter washing or damping the channels. The capacity of the sludge tank is 900 gallons and that for the clean water 1020 gallons, while the capacity of the waste water tank is 95 gallons and the vacuum tank 165 gallons. The width of road that can be washed at one passage is 8ft., while the sprinklers can cover a width of 50ft. The area washed with one tankful of water is claimed to be 5000 square yards, and 4½ miles of road, 10 yards wide, can be washed per day of eight hours. The area which can be sprinkled with one tankful varies according to circumstances from 50,000 to 60,000 square yards, or from 2 to 2¾ miles of road, 40ft. to 45ft. wide. The number of gullies which can be emptied, we are informed, with one discharging is about 250.

A feature of importance from the sanitary point of view is that the sludge is never exposed to the atmosphere until it is finally discharged. In tests recently carried out with the machine in London, 160 gullies, varying from 7ft. 6in. to 10ft. deep, were emptied in eight hours, inclusive of two journeys to the tip, which occupied two hours. In a shorter test which came under our own observation recently in Leeds eight gullies were emptied, including the travelling time, in six minutes. Two men are required, one to drive the engine and the other to handle the suction and sealing pipes.

Electricity Supply *versus* the Independent Power Plant.

The Bradford Engineering Society and the Leeds Association of Engineers held a joint meeting at the Bradford Technical College on Monday, October 17th, when a paper entitled "A Word in Favour of the Independent Power Plant" was presented by Mr. Kenneth Mountain, for his father, Mr. W. C. Mountain, who was unfortunately indisposed.

The main object of the lecture was to show that whilst certain advantages undoubtedly arise from the installation of very large generating units in superpower stations, it is doubtful whether the expensive distribution system which is necessary for coupling up such stations at considerable distance apart will not involve an expense in interest and depreciation, additional staff, &c., which will increase the ultimate cost of the electricity delivered to consumers to such an extent as to be considerably higher than that at which they can, under favourable conditions, generate the power themselves. The lecturer suggested that an independent plant was justifiable whenever it could produce the required power, after allowing for all charges, both operating and capital, more cheaply than the same power could be purchased from the available outside supply. But the relative cost was often difficult to determine in advance on account of the intricacies in the methods adopted by supply companies for fixing their charges. What with maximum demand, power factor, coal adjustment, cost of cable, transformers, &c., it was often practically impossible for consumers to know beforehand what they were actually going to pay per unit in their works, and the making of an agreement with the power company had become a very complex matter.

The cost of supply with independent plant was next considered. The importance of the fact that in any condensing plant, including the big supply stations, 60 per cent. of the heat in the coal burnt was inevitably wasted in the condensing water could not be exaggerated. It was shown that the greatest point of advantage which the isolated plant had over the large power station was the facility which the former afforded for utilising the heat in the exhaust steam, and thereby avoiding the enormous loss alluded to. Examples were given showing how exceedingly economical it was to put down a steam generating plant utilising the exhaust steam or pass-out steam at varying pressures for process work.

It was often a question of reorganising an existing power plant or of closing it down and taking current from a supply power station. In such a case there was often a tendency to compare the performance of the antiquated independent plant with the results obtained in up-to-date power stations, to the great disadvantage of the former; but by modernising an old plant, without resorting to combined power and heating, the coal consumption had often been halved, bringing the plant well into line with the possibilities of central station supply.

An independent plant might consist of internal-combustion engines, with which some of the most efficient power stations in existence were equipped, and if steam boilers were installed to utilise the waste heat in the exhaust gases, it was possible to reduce costs very much below the cost of current from power companies at the present time.

The lecturer finally considered the reliability of the independent power plant, which, considering the risks which the consumer had to run in taking current at very high pressure over an extended area, he regarded as a point in its favour. Breakdowns were not unknown in central station practice, and there were many instances which were never reported.

BOOKS RECEIVED.

Northampton Polytechnic Institute, Session 1927–28. London: Northampton Polytechnic Institute, St. John-street, E.C. 1.

Trade Unions and the Law. By Arthur Henderson. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 8s. 6d. net.

Problems in Structural Design. By Carlton T. Bishop. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. net.

Hydraulics. Third edition. By E. H. Lewitt. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

The Care and Operation of Machine Tools. By J. W. Barritt. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 13s. 6d. net.

Overhead Electric Power Transmission Engineering. By W. T. Taylor. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 35s. net.

Spectroscopy. Third edition. Vol. III. By E. C. C. Baly. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 22s. 6d. net.

London University Guide and University Correspondence Calendar, 1927–1928. London: University Tutorial Press, 32, Red Lion-square, W.C. Price 2s. 6d. net.

The Elements of Machine Design. Part I. By W. C. Unwin and Professor A. L. Mellanby. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 15s. net.

The Deterioration of Structures in Sea Water. Seventh (Interim) Report of the Committee of Institution of Civil Engineers London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Conditions.

Last week's quarterly meeting of the Midland iron trade did not produce any convincing sign of a new buying movement, and this week the policy of hand-to-mouth purchasing, which has persisted now for months, was continued. It is true that the number of inquiries in circulation continues to increase, as does the number of small scale transactions, but there is no disposition to enter into long-date contracts for supplies in bulk. The market is over-supplied, though the primary industries are under-employed. In no department of the market is any difficulty experienced in obtaining early deliveries, so that restricted and frequent buying is likely to continue unless terms particularly favourable to the consumer are offered. Gone are the days when customers were compelled to make contracts well ahead to be sure of supplies, increased productive power and decreased consumption being jointly to blame. The usual autumn enlivenment of demand for iron and steel has not yet made itself evident, and many iron and steelmasters are beginning to despair.

Pig Iron.

Fair sales of pig iron have been made this week, but orders are still for small quantities, deliveries being obtainable within a few hours. The stiffening of prices has forced consumers to the conclusion that values have reached their lowest point, and that to buy now is to buy profitably. Consequently though there has been no spectacular improvement in demand, the movements in this department have been the feature of the week. The further drastic curtailment of production brought about by the closing down of a further five blast-furnaces last month, reducing the total number of active furnaces in the kingdom to 160, has brought supply into close relation to present demand, and users are considering the possibility of a shortage of supplies should there be any material improvement in trade. Stocks at the furnaces have now been brought very low, and smelters are considerably relieved. On 'Change to-day practically all sellers asked increased prices for their products. For Derbyshire No. 3 foundry some houses wanted £3 7s., though there were a few which accepted £3 6s. for good orders. Northamptonshire makers would not do business at below £3 1s. Prices of forge qualities were steady.

Finished Iron.

The position in the Staffordshire finished iron trade is unchanged, last week's quarterly meeting not having brought out any great quantity of new business. Makers of marked bars continue to be better employed than other departments, but mills are not working up to full capacity. Best bars are making £13 per ton. The unsatisfactory price and trade situation in the Crown bar departments is unrelieved, and competition for the meagre amount of business coming on to the market is keen. Quotations for leading South Staffordshire Crown bars still move between £10 5s. and £10 15s. These limits, wide though they are, are not wide enough to include the full range of prices, however. Lancashire bars are nominally £10 5s., but supplies are to be had, it is claimed, at 5s. per ton less. The lowest price on the market for Crown bars, however, is in the region of £9 12s. 6d. Only a sluggish trade is being done in chain and cable iron. Nut and bolt and fencing iron sells very slowly at £9 upwards. The nut and bolt mills now depend almost entirely on Belgium for their raw material. Pending the return to regular production in the motor car industry, they are making but small output. The busiest department is that of cast iron pipes, that business having received a tremendous impetus from the system of rotary casting. The builders of rolling stock are in a strong position, with very good order books, and are calling for a fair quantity of best iron. Wrought iron gas tube strip is obtainable at £11 12s. 6d.

Steel.

Steel does not appear to be in any better demand than of late, and there is no material displacement of prices, which are firm. Angles and joists remain at £7 12s. 6d., ship, bridge and tank plates at £8 7s. 6d., boiler-plates at £11 to £11 10s., Staffordshire hoops at £10 10s. at works. Structural steel is not called for in any quantity, but foreign supplies have practically ceased. Imported steel prices, which were slightly firmer last week, are upheld; and the same remark applies to soft billets, which are now named £5 3s. 6d. It is unfortunate that very few of our excellently equipped steelworks can be run to anything like their full capacity, the outlet for the production being insufficient. The present small output has to bear very heavy overhead charges, resulting in increased cost of production and high prices at a time when competitive prices are urgently needed.

Sheet Values.

Though galvanised sheet mills have a little more work on hand, there are some with unallotted capacity, which they are anxious to fill up, and on 'Change in Birmingham to-day—Thursday—prices as low as £13 15s. were quoted for 24-gauge corrugateds. Local mills report an increase in inquiries, both on home and export account, and for the most part ask £13 17s. 6d. for their output, while yet a few adhere to the £14 quotations.

Trade Returns.

Taking into account that during September five blast-furnaces were blown out, it is considered very satisfactory that the production of pig iron should have amounted to 591,500 tons. This compares with 596,100 tons in August, and 645,800 tons in July. The production includes 195,900 tons of hematite and 205,400 tons of basic, 146,000 tons of foundry, and 20,500 tons of forge pig iron. The production of steel ingots and castings showed improvement, amounting to 777,000 tons in September, compared with 643,100 tons in August, and 687,100 tons in July. It is noted with some pleasure that the imports of iron and steel last month were less by £906,000 than in the corresponding period last year, though it is recalled that they were £702,000 more than in September, 1925. The total quantity of iron and steel imported during the month was 312,018 tons, valued at £2,421,406, compared with 445,704 tons and £3,327,812 in the corresponding month of last year. For the year to date the quantity imported was 3,504,821 tons, valued at £26,962,342, compared with 2,402,230 tons and £19,394,153 in the preceding year. While imports are decreasing it is good to know that exports continue to show a steady increase, the quantity of iron and steel sent abroad last month being to the value of £2672 in excess of the same month last year. As a matter of fact, the most encouraging figures in the trade returns for the month are those relating to iron and steel exports. Though locally our ironmasters continue to deplore the state of the industry, the national returns show that a distinct improvement is taking place. Not merely are the exports for September up substantially, but for the nine months the increase as compared with the corresponding period of last year is no less than nearly £8,000,000. A more satisfactory comparison in view of last year's unsettled conditions is that they are nearly a million and a half over the first nine months of 1925.

Institute of Mining Engineers.

The annual meeting of the Warwickshire and Staffordshire Institute of Mining Engineers was held at the University, Birmingham, on Monday, Mr. L. Holland presiding. The sixtieth annual report showed that the position of the Institute continued satisfactory, the number of members on the register being 169, the same as last year. The statement of accounts showed a credit balance of £91 7s. on the year's working. Mr. L. Holland was re-elected President. Mr. A. R. Latham read a paper on "Widening a Shaft," descriptive of an operation of that character performed at a Staffordshire colliery.

Unemployment.

Following the slight increase in unemployment in the Midlands recorded a week ago, the figures I am able to give this week show, as I anticipated they would, a substantial decrease. The total number of unemployed in the Midlands for the week ended October 3rd was 129,576; by the end of the following week the figure had been reduced to 125,225, representing a drop of 4351. The improvement in the figures is spread generally over the whole area.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

Textile Machinery Exports.

Shipments of textile machinery in September, as disclosed by the Board of Trade returns for that month, were extremely satisfactory, the value being very considerably higher than the monthly average of this year, or, for that matter, of the average of the two previous years. The total value during the month was £1,042,072, compared with £647,639 in September, 1926. Exports of spinning and twisting machinery during the period under review were valued at £758,574, and of weaving machinery at £208,575. Several facts of some interest emerge from the September statistics. In the first place, Russia, which earlier in the year was one of the principal markets for textile machinery, is now easily of least importance, and the fact that shipments thence during last month reached a value of only £3489 seems to indicate that that country, temporarily at all events, is virtually a dead letter so far as this branch of British export trade is concerned. Against this, however, we have the growing exports to Germany and the Netherlands, which accounted for £128,794 and £124,682 respectively, these countries following the British East Indies, with £175,244, as the most important individual markets. Exports of textile plant of various kinds to South America were valued at £75,712, to Japan £62,000, the United States £45,573, France £38,856, China £31,636, and Australia £22,327, whilst shipments to "Other European Countries" amounted in value to no less than £269,371, following on exports valued at £177,460 in August.

Artificial Silk Plant.

Naturally, in view of the striking growth of the artificial silk industry, textile machinery makers in Lancashire in recent years have been devoting increasing attention to the production of machinery for use in the manufacture of this product, more particularly in view of the fact that the home market for plant for the cotton textile industry has been severely hit by the long-continued depression in that branch. More than one of the engineering firms in this district are turning out this class of plant, and this week there are reports of other concerns carrying out experimental work in this direction. It is interesting and appropriate, by the way, to note the remarks of Mr. A. H. Rocke, in the course of a paper read last week-end at the meeting of the Textile Institute in Edinburgh. Mr. Rocke, who is connected with a Lancashire firm of textile engineers, said that while, both in this country and on the Continent, rapid strides had been made in plant for spinning artificial silk, little attention had been devoted to designing machinery specially adapted to obtain the best results on the woven fabric. Textile trade finishers, so far as could be ascertained, were, he said, endeavouring to utilise machines and processes commonly employed in the finishing of cotton goods rather than go to the expense of installing such plant as was now available. In this respect, finishers of natural silk were obtaining highly satisfactory results on the artificial product, because their machines, which were originally designed for natural silk, were proving suitable for the requirements of artificial silk.

Awaiting the Cheaper Motor Engine.

A passage in the lengthy address of Sir Frederick W. Lewis at the annual meeting of Manchester Liners, Ltd., last week, referred to anticipated developments in connection with the motor engine for marine purposes. It was pointed out that the tonnage at present owned by the company was still adequate for all its requirements, and whilst sufficient resources were available to undertake any building programme that the trade of the port of Manchester might require, the directors were at present holding their hand in the hope that it might not be necessary to contract for any further tonnage before the motor engine had become so cheapened and developed as to make it economical for the company's services.

Electricity on the Farm.

The South-East Lancashire Advisory Board is considering a scheme which has been submitted to it for the supply of electricity to rural areas in East Cheshire. The scheme has been examined by the Board's engineers, who have recommended its adoption except as regards a portion of Woodford, near Wilmslow.

Non-ferrous Metals.

Tin remains a highly nervous section of the non-ferrous metals market. There are, however, indications that the undertone is somewhat healthier than it has been for a week or two, and in spite of rather lower levels having been reached in the course of the week than those current at the time of writing, the position at the moment appears to be rather steadier, and, on balance, prices for cash metal are only about 10s. a ton lower than they were a week ago, though the loss on forward metal has been slightly heavier. Trade users have displayed a little more interest at the lower levels, but the bulk of the transactions are still largely of a speculative character. There are rumours afloat that an international agreement is on the point of completion to regulate the price of tin at £300 a ton. No confirmation of this is available, and the rumours have had no apparent effect on the market. Notwithstanding the fact that the trade demand for copper is on a quiet scale, still this section of the market has acquired added strength, largely as the result of "bullish" reports regarding stocks of the metal, and current quotations are higher than they have been at any time since about the end of August. Moreover, market expectations or hopes of a continuance of the upward movement have had the effect of instilling among sellers an attitude of increased reserve, and supplies have been less freely offered. Lead is a shade stronger than it was a week ago, although there has been no sign of improved trade buying. In the case of spelter, however, there has been rather more activity than of late and the advance reported last week has been about maintained.

Pig Iron.

On the pig iron market here during the past week there have been grounds for the suspicion that the autumn buying movement which set in four or five weeks ago, if it has not run its course, has at all events experienced a temporary lull. There are still sellers of Midland irons who are able to report a relatively satisfactory trade, but, on the other hand, there are makers who have been booking steadily since the improvement set in, and who are ready to confess this week that inquiry from users on this market has slackened off. This, of course, is not altogether unexpected, for a number of consumers must by now have fully satisfied their requirements for some time ahead. Some of the leading Derbyshire makers have fair tonnages on their books in the aggregate, and the delivery of the material will ensure activity at the blast-furnaces for some time before the danger of an over-accumulation of stocks recurs, assuming that there is a continued falling off in the demand. There has been a shade more inquiry about for hematite iron, but the demand for both Middlesbrough and Scottish brands has been quiet. For delivery Manchester or equal, Derbyshire No. 3 is quoted at 73s. 6d. to 74s. per ton, Staffordshire at 73s. 9d., Middlesbrough at 80s. 8d., Scottish at 80s. 6d., and hematite at 86s. 6d. Orders for Lancashire bar iron are still on a limited scale, although prices are unchanged at £10 for Crown quality and £9 10s. for seconds.

Steel.

In the steel market here buying generally is still on a moderate hand-to-mouth scale, and whilst there is a quietly steady business passing in the case of joists and sectional materials and of tank plates, the demand for boiler plates and for steel bars is particularly slow. There has been little alteration in the general price situation, however, ship and tank plates still being quoted at £8 7s. 6d., joists and sections at £7 12s. 6d., steel bars at £7 15s. to £8 10s., and boiler plates at from £10 15s. to £11 per ton. The market for galvanised sheets continues in an inactive condition and lower prices have been indicated during the last day or two, about £13 10s. per ton f.o.b. having been unsuccessfully quoted in connection with a large parcel of 24-gauge materials. The movement of continental steel has been slow, although a little improvement in inquiry was reported at one time. In some varieties quotations have weakened to some extent, sheet bars now being offered at £5 2s., billets at £4 18s. 6d., joists and steel bars at £5 12s. 6d., wire rods at £6 7s. 6d., Siemens plates at £7 10s., and Thomas plates at £7 2s. 6d. per ton, including delivery to Lancashire buyers' works.

Manchester Association of Engineers.

The opening meeting of the winter session of the Manchester Association of Engineers was held on Friday, 14th inst., at the Engineers' Club, Manchester. Mr. S. H. Heywood, president, was in the chair. The proceedings opened with the presentation of the Constantine Medal to Mr. George E. Windeler, M.I. Mech. E., for his paper on "Internal Combustion Locomotives," and the Butterworth Medal to Dr. T. B. Morley, M.I. Mech. E., for his contributions to the discussions during the past session. Mr. Heywood, in the course of his presidential address, referred to the care which was necessary in the handling of human personality in the engineering industry. He said

that in industry a point was reached where management ceased to be a science but became an art—"true art, which was spontaneous and its keynote sincerity." The art of management called for those qualities which promoted the sentiments of kindliness and good feeling which were essential to happy human relationship. The evening's proceedings concluded with a smoking concert.

BARROW-IN-FURNESS.

Hematite.

There is rather a better tone in the hematite pig iron market, which shows signs of being maintained. Customers' orders and inquiries suggest more confidence, and orders which are being placed are for a little greater tonnage. There is a slight tendency for overseas trade to develop, and a cargo of pig iron has gone to Hamburg. It is also likely that in the early future there may be shipments of pig iron to America. The fact that the steel departments are fairly well employed means that, at Barrow, much iron is required on that account. Therefore, with the improving market, stocks are not likely to accumulate to any extent. The trade in Cumberland is slightly better. In the iron ore trade there is a moderate demand, and the new Florence Pit in Cumberland is again working. Imports of foreign ore are fair, in sympathy with the moderate demand which exists. The steel trade is assured of a run for the next few months, and a few more orders may come along. This week there are shipments of rails from Barrow to India by a City liner and a Clan liner. The hoop and small section department is well engaged, and is well booked ahead.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

THE steel trade of this district appears to be experiencing, at the present time, a partial revival in some branches coupled with a decline in others. The unsatisfactory side is that devoted to the production of basic open-hearth steel, the demand for which has been tapering off for some time. The number of basic furnaces in operation has now fallen to about a third of those installed in the district. At Rotherham, important rail and other mills have gone on short time owing to lack of orders. On the other hand, there is an increased call for acid steels, and the volume of specifications for railway material shows an improvement. The heavy forges are very short of work. The rolling mills are slack so far as rods are concerned, and are finding some shrinkage in steel sheets, a department which has enjoyed a good deal of activity during the year. At some of the leading houses which make expensive and special alloy steels conditions are somewhat better. There is a fair amount of optimism with regard to the early future, so far as the finished steel sections are concerned.

The Lighter Trades.

Quietness continues in the file and saw trades, but large quantities of small tools are being turned out for motor kits and the use of mechanics. Firms catering for tools employed in building and other constructional work, and in road making, have had a very busy time this year, but the trade has now declined considerably. There is not much being done on the roads of the country at present. An interesting innovation is the adaptation of stainless steel for the manufacture of pen nibs. The steel pen industry has always taken the whole of its material, consisting of thin steel sheets, from Sheffield, the bulk of the trade being in the hands of one large firm. Stainless steel is now being sold to the pen makers, and there is on the market a fountain pen with a nib of Firth's Staybrite steel, which is claimed to be equal in service to the customary gold, and is very much cheaper, the retail price being only 1s. 3d. There has been a considerable improvement in the cutlery and plate trades during the last few weeks. All branches appear to be benefiting, and production has reached a larger volume than the city has known for many years.

Coal Stoppage Costs £300,000.

Evidence of the disastrous effect of the coal stoppage of last year continues to come forward, and nothing more striking in this respect has been published than the annual report of the United Steel Companies, Ltd., for the twelve months ended June. The company, as I need not remind readers, is a very large and comprehensive combination, possessing its own sources of raw material, both coal and iron, and full equipment for the manufacture of steel. The report states that the whole of the steel and ironworks, collieries, coking plants, ore mines and quarries were idle, owing to the coal stoppage, during the greater part of the first half of the financial year. The directors are satisfied that the company's loss from the coal stoppage exceeded £300,000, and they have transferred that amount from reserve. Including this, the amount brought to credit of profit and loss account is £357,148. After deducting debenture and obligation interest, and other payments and losses of certain subsidiary companies, the surplus as at June 30th was £472,016, as compared with £520,908 a year before. With regard to the future, the directors state that, while they are unable to forecast the progress of the industry, they are satisfied that the earning capacity of the various properties of the company remains unimpaired. They add that "in their opinion a large measure of prosperity will again be experienced when the relative value of iron and steel more closely approximates that of other commodities, and when more favourable conditions prevail in demand and in the cost of transport and other services, and of local taxation—all of which so seriously affect the cost of production."

Smoke in Steel Making.

Sheffield has often been urged to abolish its smoke and has often pointed out that it has its peculiar difficulties in the matter. Although there is no special agitation against the Steel City at the moment, a clear statement of the difficulties which was made last week by Professor C. H. Desch, Dean of the Faculty of Metallurgy in the University, is of interest. Lecturing on "The Diminution of Smoke," he remarked that steam boilers, when properly stoked, should not produce smoke, but it was quite different with metallurgical furnaces. He said that the statement, sometimes repeated, that Pittsburg had succeeded in abolishing steelworks smoke was entirely erroneous. In the heating of solid steel it was necessary that the atmosphere of the furnace should not act chemically on the surface of the steel in such a way as to remove carbon. That was the more important the higher the quality of steel being made. The special Sheffield products, high carbon steel and alloy steels, were particularly sensitive to treatment of this kind. When a furnace was supplied with so large a quantity of air that combustion was complete, and there was no smoke, the atmosphere was so strongly oxidising as to injure such steels, and the injury was only guarded against by keeping the furnace full of a somewhat dense smoke during heating. It might be found, he added, that atmospheres might be obtained which were free from smoke and yet would not remove carbon from the surface of the steel, but apart from that solution there was the important possibility of consuming the smoke after it had done its work in the furnace. That was the most obvious direction for improvement. He advocated the use of high chimneys in place of the short stacks which are so common in metallurgical plants.

A New Coking Plant.

John Brown and Co., Ltd., have placed with Messrs. Simon-Carves, Ltd., an order for the erection of a modern coking plant at Rotherham Main Colliery. The new battery will consist of 28 regenerative "underjet" ovens of the latest type, and will be designed to carbonise 3000 tons of washed slack per week. It will replace two existing batteries of 30 and 35 ovens, of the waste heat type, which were started in 1902 and 1904 respectively, and have since been in continuous operation. The battery will be equipped with the most modern machinery for charging the coal into the ovens and for discharging and subsequent handling of the coke. The whole installation will be designed with a view to reduce operating costs to a minimum, and to enable coke of first-class quality to be produced in the most economical manner. The "underjet" oven is the latest development in coke oven design, and is distinguished by the simplicity and certainty of the method of gas distribution for the heating of the ovens, whereby it is claimed that absolute uniformity and intensity of the heating of the oven chambers is ensured. The order also includes the remodelling and replacement of the existing by-product recovery and treatment plants, so that the whole plant as finally completed will be thoroughly up to date and efficient.

A Satisfactory Report.

The report of Samuel Osborn and Co., Ltd., for the year ended July makes satisfactory reading. The firm is a large manufacturer of railway material, tools, high speed steel, stainless steel, and other commodities. The balance of profit was £31,907, and, after allowing for the dividend on the preference shares, it is proposed to pay 5 per cent. on the ordinary, and carry forward £9425. The directors state that, considering the disastrous coal stoppage, which affected the economical working of the company for five months of the financial year, they are of opinion that the results are satisfactory. They are pleased to report that, notwithstanding the very keen competition, the sales for the first two months of the current year show an improvement.

Recent Contracts.

An order for steel tram rails for the Mersey Docks and Harbour Board has been received by Hadfields, Ltd., of Sheffield. The same firm has also recently booked contracts for special tramway track work for the Liverpool, Glasgow, and Manchester Corporations, and for the Leopoldina, Buenos Ayres Western, and Buenos Ayres Great Southern Railways. Robey and Co., Ltd., of Lincoln, have secured orders for two pairs of their drop valve steam winding engines for the North of England. They are two of the largest sizes the firm has constructed, one being a repeat order.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

ALTHOUGH the volume of business passing is somewhat lighter than it has been, an optimistic view continues to be taken of the outlook, and it is generally felt that the present lull is only a temporary phase. Inquiries circulating are still fairly numerous, and are from customers over a wide area. Export sales are much below what could be desired, but indications of an early improvement in overseas business are not entirely absent. Values of Cleveland pig iron are maintained, notwithstanding efforts of continental competitors to regain, by further price cutting, the trade which they lost by the last reduction in prices of Cleveland iron. The concessions which foreign makers are now prepared to grant appear to be insufficient to attract much business. A sale of foreign iron has been made locally this week on terms only a shade more advantageous than the Cleveland prices, and is ascribed to a protest against the ruling differential rates for home and export adopted by Cleveland makers. While demand for Cleveland qualities is somewhat quieter, current needs continue on a larger scale than can be met by the restricted output, and stocks are still being heavily drawn upon. Continental customers are taking up small parcels of the marketable iron, but most of the pig iron available is still purchased by local founders and by firms beyond the Tweed. For home use No. 1 Cleveland foundry iron is 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s.; while for dispatch to Scotland and foreign ports 2s. 6d. below these quotations is accepted.

Hematite Pig Iron.

The market for East Coast hematite pig iron is unsteady. There is a prospect of more iron coming forward by the end of the month as the result of a furnace being put into operation at the Ayresome Ironworks of Gjers, Mills and Co. Mixed numbers are offered freely at 72s. 6d., both for home consumption and for export, but buyers are unwilling to pay so much and state that they can arrange contracts on lower terms.

Iron-making Materials.

Lifeless conditions prevail in the foreign ore trade, but the market continues firm on the basis of 21s. per ton c.i.f. Tees for best Rubio. The unprofitable prices at which Durham blast-furnace coke makers seek to dispose of their output fail to attract local consumers. Good average qualities are offered at 18s. per ton delivered at the works.

Manufactured Iron and Steel.

Manufactured iron and steel prices are steady, and firms in this area appear to be securing a fair share of the orders coming forward. A few good sales of constructional steel for building purposes are reported, and further contracts for shipbuilding purposes have been arranged under the rebate scheme.

The Coal Trade.

There is no special feature in sight to relieve the dull and easy tendency in the Northern coal trade. Fitters have a fair amount of orders on hand, but could readily deal with a considerably enlarged demand. Foreign buyers are only operating for hand-to-mouth quantities, and their orders are placed mainly through second-hand sellers whose prices are much below the prices asked by fitters. The position in the Northumberland steam coal section is very disappointing, and owners are having difficulty in many instances in keeping their collieries employed. Fitters hold to 13s. 6d. to 14s. for best steams, and declare that they will not cut these prices. On the other hand, the contractors have to find a market for their commitments, and to tempt consumers have to make very substantial reductions, which for early clearance amount to over 1s. per ton. Hastings or similar, and Tyne primes are nominally quoted by producers at 13s. 3d. to 13s. 6d., but against these figures merchants have to face the competition of bests at much lower prices. Definite values, therefore, depend on individual positions. There is an easy feeling in Durham steams at 15s. to 15s. 6d. Steam smalls range from 9s. to 10s. 6d., according to brand. The Durham gas coal trade position is fairly good, but production in many instances has to be curtailed. Best qualities are steady at 15s. 6d. to 16s., and seconds at 13s. to 13s. 6d. Coking unscreened coal is in plentiful supply and weak in tone at 13s. to 13s. 3d. Unscreened bunkers are quiet at 13s. 3d. for ordinary and 13s. 9d. to 14s. 6d. for best and special qualities. Buyers of gas coke are numerous, but find supplies meagre for a month ahead, and for any parcels available for shipment the tone is very firm at 21s. to 21s. 6d. Furnace cokes are in better demand for the home furnaces, but supplies are ample at unchanged prices. Patent cokes are quietly steady, good makes at 17s. 6d. to 18s., specials 24s. to 26s., and beehive 25s. to 30s.

Coal-loading Problems.

The question of the coal shipping facilities on the Tyne is claiming the attention of the Newcastle Coal Exporters' Association, and at a recent meeting it was agreed that the provision of means whereby damage to coal in loading could be obviated was essential, and the importance of up-to-date grading and screening processes was stressed. In the present unprofitable state of the coal industry, however, it may be doubted whether any colliery would be prepared to meet capital expenditure in this direction. On the other hand, those colliery companies which have installed modern screening plant complain that their efforts are to a large extent rendered futile owing to the damage done to the coal at the loading staiths, so that it seems reasonable that this part of the problem should be tackled first. In view of the fact that Silesian coal, which is entering into very severe competition with the British product, is both well screened and carefully handled, the importance of the matter is apparent.

Shipbuilding Order for Tyne Firm.

It is announced that William Dobson and Co., Walker-on-Tyne, have booked an order for a cargo steamer of about 8500 tons deadweight for the R. B. Chellow Steam Navigation Company, Cardiff. The engines, it is understood, will be supplied by Dickinson and Son, Ltd., Sunderland.

SCOTLAND.

(From our own Correspondent.)

Continued Depression.

THERE are no signs of an early improvement in the steel, iron and coal markets and the outlook for the winter months is causing considerable apprehension. Shipbuilding contracts have recently been placed in greater numbers, but they cannot have any immediate effect on the situation, nor do such orders mean that prices have reached a competitive level, as owners have in many instances made sacrifices in order to provide British shipbuilding yards with work, probably in the hope that home costs will soon assume a level more congenial to all. So far as can be ascertained, the rebate scheme introduced by the steelmakers has not been an unqualified success, though, of course, the scheme may ultimately have beneficial effects on the Scottish steel industry. In the mean-

time, there seems to be a lack of confidence in the steel, iron and coal markets, and neither buyers nor sellers are inclined to take any risk, and the general depression is very evident. Steel makers continue to work their plants at a rate far below capacity. Shipbuilders have specified a fair quantity of heavy material, but the output capacity of the works is in no wise taxed to meet all demands. Consequently, costs are higher than they might be, and the possibility of lower prices seems remote. Tube makers have a fair demand for butt-welded descriptions, and works thus engaged are fully employed, but those interested in lap-welded and solid-drawn tubes are not so favourably placed.

Steel Sheets.

An improvement in the demand for light black steel sheets is reported, but the heavier gauges are very lifeless. Galvanised corrugated sheets are somewhat better off, with the price round about £14 per ton, and perhaps a shade less for a good specification.

Iron.

The bar iron trade still experiences quiet times, and apparently suffers from a preference for re-rolled steel bars owing to the cheaper costs of the latter, which, however, are not by any means busy. In fact, both departments would welcome a considerable increase in business. Prices of bar iron are unchanged, and re-rolled steel bars at £7 15s. home and £7 7s. 6d. per ton export are unchanged also, but can be bought on better terms when a good order is in prospect.

Pig Iron.

The pig iron market is very dull, and the present rate of inquiry does not hold out hopes of improvement. The output has been curtailed, but is still more than ample, and with stocks accumulating prices continue to show a weakening tendency.

Exports and Imports.

Imports of iron ore at Glasgow last week totalled over 8000 tons. Manufactured and semi-manufactured iron to the extent of 1600 tons, including 1000 tons of iron plates from St. Nazaire, were unloaded. The imports of pig iron amounted to some 1500 tons from India. Exports of iron reached a total of 5800 tons.

Coal.

Apart from an improvement in home demands, owing to the advance of the season, there is little change in the Scottish coal trade. Lanarkshire ells have received orders for the Irish market, and splints have regained the position lost through some forced selling, but most descriptions of round fuel usually sent abroad are badly off for new business. Foreign importers are averse to paying current prices, while home collieries are disposed to insist on enhanced rates. Consequently, shippers act very cautiously, and practically nothing but minimum requirements for immediate consumption are considered. Washed treble nuts are an exception, these being firm in all districts. Aggregate shipments amounted to 272,213 tons, against 278,271 tons in the preceding week and 254,522 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

The general state of trade has again been very disappointing, as it cannot be said that business has displayed any expansion. The irregularity with which collieries are working is as pronounced as ever; in fact, the list of pits which have had to stop has been added to, so that the total of unemployed has been increased by about 2000. The inactivity which has prevailed is evident when it is stated that at the end of last week there were no less than fifty-seven idle tipping appliances at the various docks as the result of the shortage of orders and tonnage. This is a record number, and, of course, means not only reduced work at the collieries, but a considerable amount of idleness at the docks and loss of earnings. Fortunately, arrivals of steamers over the week-end improved the situation, as on Monday the number of idle tipping appliances was reduced to thirty-seven, which is bad enough. The volume of chartering which is proceeding daily does not give one much hope of seeing a material improvement, however, so far as the near future is concerned, and it is very doubtful whether the export figures for the current month will mark an advance upon those for September, when, according to the Board of Trade returns, the total was 1,870,952 tons, as against 1,713,202 tons for August. This advance during September, as compared with the previous month, was due entirely to the increased activity in shipments of anthracite coals to Canada, which more than made up for the actual falling off in the exports of steam qualities. Returns of exports for the current month are very unsatisfactory, as for the week ending the 14th inst. the total was only 343,624 tons, which was over 70,000 tons less than for the preceding week. There will have to be considerably more activity during the second half of the month if this leeway is to be made up, but it is to be feared that there is not the business about to enable it to be done. Naturally some interest has been aroused by the news that there is a stoppage of work in the mining area of the Asturias, and that 80,000 men are on strike in the lignite districts of Rhenish-Westphalia and Central Germany, but stocks of coal abroad are so heavy that few hold out any prospect of the Welsh coal market being favourably affected for some time at any rate.

Spanish Coal Restrictions.

News received at Cardiff during the past week regarding the contemplated action on the part of Spain respecting the importation of coal has been very disconcerting, if not alarming, as according to a well informed correspondent, it is the intention to set up in Spain a national coal buying agency with complete control over all coals imported and under the authority of representatives of the Spanish colliery owners; further, that the contracting for imported coals from this country should be done through one agency on this side. It is stated that already negotiations have been opened by the central buying agency in Spain with a particular firm representing one of the leading groups of collieries in South Wales for the supply of 1½ to 1¾ million tons of coal. Such a scheme is regarded in coal trade circles as very dangerous to the interests of both countries. The matter is being very closely followed by the Coal Exporters' Federation, and, according to Mr. Finlay Gibson, the facts of the case are being considered by the colliery owners with a view to making representations to the Government. In the view of Mr. Gibson, who is the secretary to the South Wales Coalowners' Association, the action of the Spanish Government is a violation of definite pledges of non-interference with the channels of trade made at the time the Anglo-Spanish Commercial Convention was made early this year.

The Tin-plate Trade.

There has been no marked change in the tin-plate industry of late, although it is reported that one or two works have restarted this week. The men's representatives on the Welsh Tin-plate Joint Industrial Council met on Monday to consider further proposals relating to the avoidance of unemployment in the industry and the devising of a superannuation scheme. The idea of working shorter hours to enable the available work to go round having been rejected by a ballot of the workmen, the proposal was put forward that a levy should be made on those actually in employment, but no finality was reached and the whole matter was left to a future meeting. The tin-plate pooling scheme, which was introduced in the industry in this district last February for the purpose of stabilising prices, &c., came to an end virtually at the end of last month. According to one authority no pool could possibly operate successfully with a demand which is only 50 per cent. of capacity, and the position is that for the current month payments so far as the pool is concerned have been suspended altogether, but steps are contemplated by which payments may be resuscitated at an early date in a modified form.

LATER.

There was a more cheerful tone in Exchange circles at Swansea on Tuesday respecting the tin-plate trade. Reports were current of several works having booked up substantial orders, amounting in the aggregate to one million boxes. The result is that some works are booked up to the end of the year and others well into 1928. Owing to competition, however, values have declined, and the suggestion has been put forward of endeavouring to establish a minimum selling price.

Current Business.

The flow of business in steam coals continues to be very meagre, and market values, while being very irregular, are certainly no better. There are no large coals which are quoted above 19s. 6d. to 20s., and indeed the latter figure is extremely difficult to get even for the very best quality. Sized coals are in relatively good demand, and command the best price, viz., up to 21s. 6d. for nuts, while smalls are very steady at 13s. to 13s. 6d. Patent fuel meets with very little fresh inquiry. Manufacturers of this commodity have now agreed to certain alterations and additions in the proposed uniform contract form, and have forwarded the amended draft to the exporters for their final approval. The pitwood market is decidedly easier and prices have fallen from 33s. to about 30s. owing to the poor demand and the fact that supplies arriving are on a slightly larger scale.

South African Engineering Notes.

Mine Temperatures.

In a paper read before the South African Institution of Engineers, Dr. J. H. Dobson, D.S.O., M. Inst. C.E., dealt with the engineering aspect of improving temperature and humidity conditions of the mine atmospheres at great depths. He said that, taking the published figures in connection with the Village Deep Mine as an example, it would appear that the wonderfully dry atmospheric air common to the Witwatersrand is nullified to the extent of about 50 per cent. of its cooling effect because of the enormous moisture picked up in the downcast shaft before the air reaches the actual underground workings. Almost any expenditure involved in the investigation of these conditions or actual cost in deviating water where possible to dry the downcast zones prior to the workings and to convey water by closed pipes wherever it could be done, would be justified, since the amount of moisture picked up in the zones referred to is, for all practical purposes, proportional to the extent of the wetted surfaces and almost independent of the volume present. If the ultimate ideal could be reached that the ventilating air picked up moisture only in the actual workings, the cooling effect would be the equivalent of putting twice the volume of air through the mine at the same costs as now, which would mean economy on a very large scale.

Cape Town Goods Yard.

The Railway Administration has decided to improve the lay-out of Cape Town Goods Yard, remove the steam sheds to Salt River, and in order to expedite the handling of traffic, which is greatly congested, provide an additional line along the foreshore, giving access to the super power station being erected there, then traversing the sea side of Salt River Works, on through Maitland Commonage and Kensington Estate, across the main road, where an overhead bridge will be built. The scheme is estimated to cost £110,000, and when completed will relieve the present main line of a considerable amount of goods traffic. It is stated that the congestion is so pronounced that it is practically an impossibility to provide relief for passenger traffic, which is abnormal.

Electric Goods Locomotive.

Peculiar significance attaches to the action of the S.A.R. Administration in inviting, on August 12th, tenders for the supply of an electrical goods locomotive. It is the desire of the railway authorities to find an electric locomotive which will be, if possible, a big improvement on locomotives at present being used on the electrified section of the Natal main line, and therefore this invitation has been extended to the electric locomotive manufacturing firms of the world. The actual design of engine is left to the tenderer, but there are certain specifications with which the tenderer must comply. The intention is to test this single unit against the three units now employed on a train. The contractor will be required to place the engine in commercial service and supervise the running for an agreed period, probably twelve months. The locomotive is to be regarded as a single unit and will be required at some future period to operate with another of similar type hauling 3000 tons. The locomotive must be capable of exerting a tractive effort of 660,000 lb. at 20 to 21 miles per hour, and of 21,000 lb. at 35 miles per hour. It must be able to reach a speed of 45 miles per hour, it must have a power of 3600 H.P., and must be capable of starting from rest a train weighing 1500 tons on a rising gradient of 1 in 65. It is understood that should this experiment be successful this contract for one electric locomotive will be the forerunner of one of the biggest contracts for locomotives in the history of the S.A.R. Administration. The attention of British engineering firms is especially called to this point, as also to the circumstance that, in view of the fact that American works have had large experience in building big electric units it behoves them to estimate as carefully and closely as they possibly can.

CATALOGUES.

British Engels Company, Windsor House, Victoria-street, S.W. 1.—Price list of "Engels" valve discs.

Henry Simon, Ltd., Mount-street, Manchester.—Catalogue dealing with "Simon" rice milling machinery.

Higgs Motors, Witton, Birmingham.—Monthly stock list of alternating-current and direct-current motors.

D.P. Battery Company, Ltd., Bakewell, Derbyshire.—Booklet, "A Century of Power, 1827–1927," describing the firm's works.

R. H. Neal and Co., Ltd., Plant House, Ealing, W. 5.—Brochure illustrating and describing the Menck patent electric shovel.

The Sherardizing Company (1926), 11, Thames-street, Sunbury-on-Thames.—Pamphlet describing the Sherardizing process.

Beyer, Peacock and Co., Ltd., Gorton, Manchester.—Particulars of various classes of "Garrett" locomotives and the work they are doing.

The Sentinel Waggon Works, Ltd., Shrewsbury.—A booklet, entitled "From Field to Factory," a practical treatise on sugar beet haulage.

John Le Boutillier, Ltd., 57, Bishopsgate, London, E.C. 2.—Description of the "Spindel" type testing machine made by the M.A.N. Company, of Nuremberg.

Silica Coke Oven and Machinery, Ltd., Aldwych House, London, W.C. 2.—Bulletin No. 2, describing a new battery of coke ovens being constructed by the firm.

William Beardmore and Co., Ltd., Glasgow.—Detailed description of a locomotive distributing gear using poppet valves made under A. Caprotti's patents.

Burt, Boulton and Haywood, Ltd., Prince Regent's Wharf, London, E. 16.—Booklet, giving particulars of the "Premier" disintegrating and emulsifying mill.

The Sturtevant Engineering Company, Ltd., 147, Queen Victoria-street, E.C. 4.—Publication No. 1074, detailing in detail with mechanical draught and cinder elimination.

Keighley Gas and Oil Engine Company, 107, Upper Thames-street, London, E.C. 4.—Catalogue giving particulars of "Imperial Keighley" cold starting, solid-injection, heavy-oil engines.

Shell-Mex, Ltd., Shell Corner, Kingsway, W.C. 2.—A book entitled "The Firing of Metallurgical Furnaces," by Mr. I. Lubbock, chief engineer of the company's fuel oil technical department.

Stewarts and Lloyds, Ltd., 41, Oswald-street, Glasgow.—"Specifications of the Institution of Gas Engineers for Wrought Iron Tubes and Fittings" and a booklet dealing with tubular steel pit props.

The English Electric Company, Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. 278A, "English Electric Rotary Converters, Supplied or on Order"; Publication No. 950, "Modern Power Equipment in an Iron and Steel Works."

The Brush Electrical Engineering Company, Ltd., Falcon Works, Loughborough.—Publication No. 1000, illustrating and describing in detail the manufacture of the Brush-Ljungstrom steam turbines and turbo generators. A number of illustrations of typical installations are given.

LAUNCHES AND TRIAL TRIPS.

Sabaneta, oil tanker; built by Harland and Wolff, Ltd., to the order of the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft.; 2360 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; trial trip, September 30th.

Nos. 819G, 820G., 821G, and 822G, tunnel tugs; built by Harland and Wolff, Ltd, for service on the Nile; dimensions, 65ft. by 15ft. by 5ft. Engines, two Widdop "Invincible" crude-oil engines; launch, October 3rd.

Preserver, salvage steamer; built by Ferguson Brothers (Port-Glasgow), Ltd., to the order of Lambert Brothers, Ltd.; dimensions, 185ft. by 31ft. 6in. by 15ft. 9in. Engines, triple-expansion; constructed by the builders; triel trip, October 5th.

Lustrous, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the Lustrous Steamship Company, Ltd.; 9000 tons deadweight. Engines, triple expansion; constructed by the builders; launch, October 11th.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 16 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 14 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 12 6	3 12 6
No. 1	3 13 0	3 13 0
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 0
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
" " Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 1 0	—
Forge	2 15 0	—
(3) Derbyshire—		
No. 3 Foundry	3 6 0 to 3 7 0	
Forge	3 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge		—
Basic	3 2 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 6 6 (a) / 4 9 6 (b) / 4 13 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 12 6 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 12 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 15 0 to 8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	14 5 0	£14 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
Manchester—		
Bars (Round)	8 10 0	—
" (Small Round)	7 15 0	—
Hoops (Baling)	10 5 0	10 0 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
" (Lancs. Boiler)	11 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	7 0 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 15 0 to 14 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	17/9 to 18/3
Block Tin cash)	261 15 0
" (three months)	258 12 6
Copper (cash)	55 0 0
" (three months)	55 1 3
Spanish Lead (cash)	20 15 0
" (three months)	21 0 0
Spelter (cash)	27 5 0
" (three months)	26 17 6
Manchester—	
Copper, Best Selected Ingots	62 15 0
" Electrolytic	62 17 6
" Strong Sheets	86 0 0
" Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
" Condenser, lb.	0 1 1½
Lead, English	22 5 0
" Foreign	21 2 6
Spelter	27 5 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
" " 6 p.c. to 8 p.c. "	£22 17 6	7/3
" " 8 p.c. to 10 p.c. "	£22 10 0	6/6
" " Specially Refined		
" Max. 2 p.c. carbon	£36 0 0	11/6
" " " 1 p.c. "	£41 10 0	15/-
" " " 0·70 p.c. carbon	£53 0 0	17/6
" " " carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 0 0 for home, £16 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/- per unit	
" " 75 p.c.	£20 5 0 scale 6/- per unit	
" Vanadium	14/3 per lb.	
" Molybdenum	5/- per lb.	
" Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/-
" " Ell	14/-
" " Splint	14/6 to 16/-
" " Trebles	14/- to 14/6
" " Doubles	13/- to 13/3
" " Singles	12/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6 to 14/-
" " Jewel	15/6
" " Trebles	14/6 to 15/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 12/6
Screened Navigation	16/-
Trebles	15/- to 16/6
Doubles	13/3
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/6 to 12/9
Secondary Steam	12/-
Trebles	14/6 to 15/6
Doubles	13/6 to 13/9
Singles	12/3

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		24/- to 25/-
Household		40/- to 56/-
Coke		22/6 to 23/6
Northumberland—		
Best Steams		13/6 to 14/-
Second Steams		12/9 to 13/-
Steam Smalls		9/6 to 10/-
Unscreened		13/- to 13/6
Household		21/- to 27/-
Durham—		
Best Gas		16/-
Second		13/6
Household		21/- to 27/-
Foundry Coke		19/- to 26/-
Sheffield—		
Best Hand-picked Branch	28/- to 30/6	—
Best Selected House Coal	22/6 to 23/-	—
Screened House Coal	19/- to 20/-	—
" " Nuts	16/- to 17/6	—
Yorkshire Hards	14/6 to 16/6	—
Derbyshire Hards	15/- to 17/-	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	3/- to 4/6	—
Blast-furnace Coke (Inland)	14/- to 14/6 at ovens	—
" " (Export) f.o.b.		18/6 to 19/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/6 to 20/-
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/6 to 19/-
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/- to 18/3
Western Valley Large	17/6 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	12/6 to 13/6
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/6 to 20/-
" " Smalls	15/6 to 16/6
No. 2 " Large	16/6 to 17/6
" " Through	15/- to 15/6
" " Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/- to 24/6
Pitwood (ex ship)	29/6 to 30/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 36/-
Seconds	28/- to 32/6
Red Vein	24/6 to 27/6
Machine-made Cobbles	37/6 to 42/6
Nuts	42/6 to 46/-
Beans	27/- to 30/-
Peas	18/6 to 20/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/- to 18/-
Smalls	10/6 to 12/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 7/6 joists and 5/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Sales' Comptoirs.

THE meeting which was to have been held this week in Brussels with a view of settling negotiations for the constitution of international *comptoirs* for the sale of girders and other steel products has had to be postponed on account of the difficulties arising out of the claims of two Belgian producers. This postponement has caused keen disappointment amongst French rolling mill owners, who fear that the uncompromising attitude of the Belgians will wreck the only combination which seems capable of giving any vitality to the steel industry and may weaken still further the influence of the Steel Union and even destroy it, for it is obvious that that body can only hope for a permanent existence by allotting to each country a definite quota for export. The primary object of the Steel Union—*i.e.*, the limitation of the production of raw steel—has not succeeded entirely in giving stability to the industry. The result is indeed disappointing. It is therefore feared that trouble will arise in the future unless international sales organisations can be formed, and it is hoped that some sort of compromise will be reached whereby the two Belgian producers, who are claiming a much larger share of the foreign trade than is justified by their limited production, will fall into line with the other Belgian manufacturers. The difficulty of coming to an understanding whenever there is a question of international arrangement is further observable in the dissolution of the Union of Nail-makers and Wire-drawers. The Union comprised all the makers in Germany, Belgium, Holland, and Luxemburg, and at a recent meeting at Aix-la-Chapelle it was found impossible to accept the claims of a Belgian maker for a larger participation, and the members had therefore no alternative but to dissolve the association. Such organisations cannot exist except on a basis of absolute unanimity.

South American Air Service.

The rivalry between the German-Spanish company and the French for the carrying out of an air mail service to South America is likely to result in the service being started earlier than had been expected. The Germans are building huge commercial seaplanes for the purpose, and they also propose to experiment with airships, and it is not likely that this vast organisation for running a line between Seville and Buenos Ayres will be ready before next spring. Meanwhile the South American States having declined to grant a monopoly of the mail service to the German-Spanish company, the French Latécoère concern, which has for a long while past been running successful services between Toulouse and Morocco, as far south as Dakar, secured a concession on condition that an accelerated carriage of mails should begin in the autumn. Being themselves somewhat behindhand with the construction of seaplanes, the French argue that it would be imprudent to start right away with a regular air flight across the South Atlantic, but, to show that that is possible, Costes and Le Brix flew last week in two stages from Paris to Saint-Louis-du-Senegal and thence across the South Atlantic, to Natal in Brazil. As the flight from Natal in Brazil to Buenos Ayres can be accomplished in a third stage it is obvious that with a properly organised service the whole journey can be done in three days. The machine used was a Breguet biplane with 550 horse-power engine, which had already been employed for long-distance flights. Until, however, commercial seaplanes are developed sufficiently in this country to ensure entire reliability there is no question of employing them on the longer sea route between Cape Verde Islands and Fernando-de-Noronha. For the service which is to be begun shortly the Latécoère Company has arranged with the Ministry of Marine to provide, temporarily, five boats which will be fitted with accommodation for ten passengers and will steam at 18 knots. The journey between Saint Louis-du-Senegal and the Cape Verde Islands and between the island of Fernando-de-Noronha and Pernambuco will probably be effected by aeroplanes.

Coal.

The demand for coal is so much below the average at this time of the year that the situation of the collieries has undergone no improvement, and while stocks are accumulating in many cases there is a notable reduction in number of men at work. The Miners' Union has had an interview with the Minister of Public Works in order to bring before him the necessity of doing something to improve the situation, but obviously little can be done in view of the fact that, despite a lowering of prices, there is scarcely any increase in the total consumption. Domestic sorts are in greater demand, but the heavy falling off in industrial fuel is, it is feared, likely to continue all through the winter, for there is no indication of any early recovery, and, in most departments of trade activity, there appears to be a continuous decline.

The Colonial Exhibition.

The Colonial Exhibition, which was to have been held in the Bois de Vincennes next year and was postponed owing to the impossibility of getting everything ready in time, is to be again put off. The date now proposed is 1931. Marshal Lyautey, who was recently appointed General Commissioner, finds that the preparations have to be carried out on a much vaster scale than had been supposed. An underground railway will have to be built to deal with the traffic. A permanent colonial palace of particularly large dimensions will be constructed. There will be a Colonial Exhibition in Antwerp in 1930, and the British Government was obliged to ask for a postponement from the original date on account of the difficulty of getting colonial exhibits ready in time. The French Government is particularly anxious to secure a large British participation, and there appears to be no doubt that when the Exhibition is opened in 1931 it will be thoroughly representative and will mark a new stage in colonial development.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

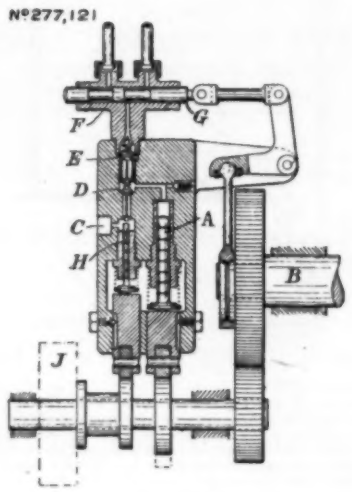
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

277,121. June 11th, 1926.—FUEL DISTRIBUTING DEVICES FOR MULTI-CYLINDER ENGINES, A. U. S. Danielson, Karlbergsvägen 89, Stockholm, Sweden.

The fuel distributing device shown in the drawing is suitable for a two-cylinder two-stroke engine. The fuel pump plunger A is driven at double the speed of the crank shaft B by the gearing

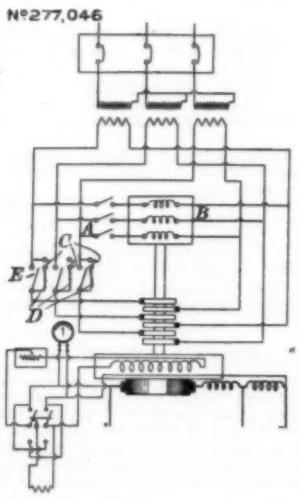


shown. The oil is admitted at C and passes up through the suction valve D and delivery valve E to the distribution chest F, where it is alternately admitted to the two cylinders by the piston valve G actuated from the crank shaft. Governing is effected by holding open the suction valve D by means of the push rod H, which is controlled by the governor J.—*September 12th*, 1927.

TRANSFORMERS AND CONVERTERS.

277,046. April 7th, 1926.—IMPROVEMENTS IN MEANS FOR THE STARTING AND SYNCHRONISING OF SYNCHRONOUS MOTORS AND ROTARY CONVERTERS, The Harland Engineering Company, Ltd., and Arthur William Maudling, both of B.E.P. Works, Alloa, Scotland.

In starting a rotary converter in accordance with this invention the switch A is closed and the starting motor B is connected across the low-tension side of the transformer. The motor consequently starts and brings the set nearly up to synchronous speed. The shunt field also builds up to the correct value.

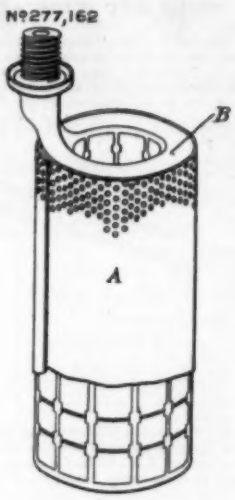


The switch C is then closed and the rotary is then connected to the low-tension side of the transformer through the buffer resistances or choking coils D, which are adjusted to pass sufficient current to pull the set into synchronism. This takes place practically instantaneously, and the current immediately falls to a very small value. Switch E is then closed, short circuits the buffer resistances and connects the rotary converter directly across the low-tension side of the transformer. The switch A is then opened and the starting motor is disconnected.—*September 7th*, 1927.

BATTERIES AND ACCUMULATORS.

277,162. August 19th, 1926.—IMPROVEMENTS RELATING TO ELECTRIC ACCUMULATORS, Benjamin Heap and the Chloride Electrical Storage Company, Ltd., of Clifton Junction, near Manchester.

The type of accumulator to which this invention applies is that having cylindrical plates, and the object of the invention is to provide improved means of reinforcing the plates, particularly the positive plates. A tubular sheath A of perforated rubber containing vulcanising materials is folded round the plate B.

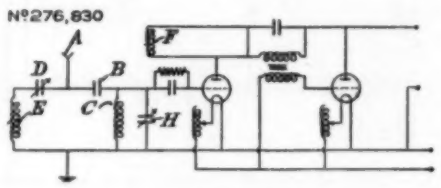


The ends are connected together with solution. The plate and sheath are then placed in a vulcaniser, which causes the sheath to shrink on to the plate.—*September 15th*, 1927.

TELEGRAPHS AND TELEPHONES.

276,830. September 1st, 1926.—IMPROVEMENTS RELATING TO WIRELESS RECEIVING MEANS, Archibald Alwyn Harrison, of "Ashville," 20, Grosvenor-road, Whalley Range, Manchester.

In wireless reception in the neighbourhood of a transmitting station, difficulty is experienced in cutting out the local station so as to obtain clear reception from more distant stations. According to this invention, two parallel wave trap circuits are employed. The aerial A is connected through a fixed or variable condenser B to one end of the coil C, the other end of which is connected to earth. One end of coil C is also connected to the grid of the detector valve, and the other end to the filaments of both of the valves. The aerial A is also connected through a variable condenser D to one end of a coil E, corresponding with the wave length of one of the two stations, the

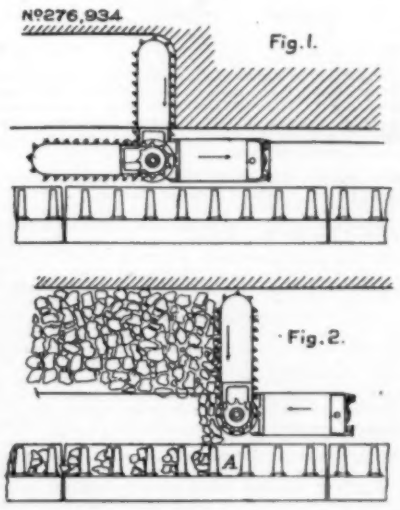


other end of the coil E being connected to earth. Thus a dual circuit connected to the aerial and earth is produced. The reaction coil F is suitable for use with the coil C. In operation, that half of the circuit which contains the condenser D and coil E is tuned by means of the condenser D until the signals from the unwanted station are eliminated. The part of the circuit which contains the condenser B and coil C is then tuned by means of the condenser H until the signals from the other station are at their optimum strength. To change over from the first-named station to the second station, it is merely necessary slowly to rotate the condenser D in the requisite direction until the more distant signals completely fade out and clear signals from the second station come in at normal strength, which takes place quickly and without any interference from the first-named station. The second half of the dual circuit then acts as a wave trap for the first-named station.—*September 9th*, 1927.

MINING MACHINERY.

276,934. November 25th, 1926.—A METHOD OF COAL MINING, *R. J. Tugwood*, 77, *Chancery-lane, London, W.C.* 2.

The idea of this invention virtually amounts to this:—A coal



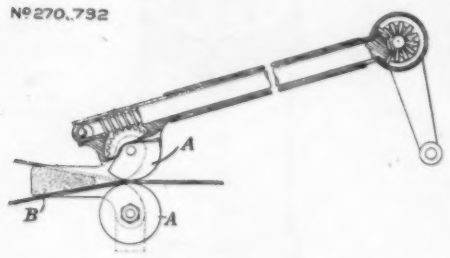
cutter is employed, as shown in Fig. 1, to undercut the coal in the usual manner. The cutter is then drawn out of the kerf and the machine is run back through the broken-down coal in

the reverse direction, as shown in Fig. 2, and in so doing drags out the broken coal on to the face conveyor A, which carries it away to the loading station.—*September 8th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

270,732. May 5th, 1927.—Shearing Machines, E. Fouquet, 112, rue Jean Jaures, Bois-Colombes (Seine), Paris.

This amounts to little more than a rotary shearing machine made portable, so that it is specially convenient for cutting curves. The cutters are shown at A A and are driven by the worm and

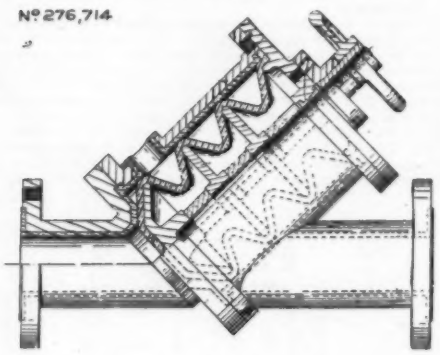


hand gear shown. The frame B is of triangular cross section in order to facilitate the passage on either side of the severed pieces of plate. It is suggested that the frame should be of alloy steel. The specification also includes arrangements for guiding the tool in cutting curves and for driving it by an electric motor.—*September 15th*, 1927.

MISCELLANEOUS.

276,714. May 3rd, 1926.—Stop Valves, N. Swindin, 4, Heathfield-road, Mill Hill Park, Acton, London, W. 3.

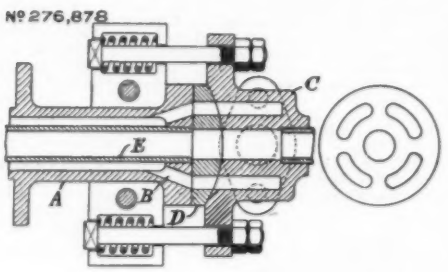
The object of this invention is to provide an improved construction of valve of the screw-down type, whereby a straight-through passage is obtained, and also to provide a construction



of valve which is particularly suitable for use with corrosive liquids or fluids in that all the exposed parts can be easily covered with rubber without interfering with the simplicity and efficacy of the valve. The means of carrying out the invention are so obvious in the drawing that no further comment is necessary.—*September 5th*, 1927.

276,878. January 22nd, 1927.—Trunnions of Steam-heated Cylinders, S. Milne, 38, Landor-road, Edinburgh.

This invention is concerned with the steam connections of rolls which are heated internally by steam introduced through their trunnions. The trunnion is shown at A and is provided



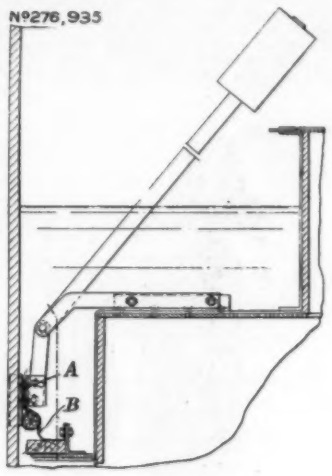
with ports B for the ingress of the steam. The steam is supplied by the fixed fitting C and between it and the trunnion there is a ported washer D. The ports are of the form shown in the cross-section. The whole assembly is held together by bolts and springs, as shown. The water of condensation is led away by the central pipe E.—*September 8th*, 1927.

272,438. January 25th, 1927.—Improvements in Electrical Insulation, *Dubilier Condenser Company*, (1925), *Ltd., of Ducon Works, Victoria-road, North Acton, London, W. 3.*

This invention relates to improvements in electrical insulation, especially insulation for electrical condensers. An object of the invention is to provide an improved electrical insulation in the form of a compound comprising a derivative of cellulose which is superior to insulation containing other similar ingredients and has a lower power factor and entails smaller electrical losses. Insulating materials for electrical purposes comprising cellulose derivatives such as cellulose acetate and cellulose nitrate, as well as those made by alkali processes, are now in common use, and are known under the trade names of Viscose, Cellon, Rayon, Collodion and Cellophane. Of these, the material known under the registered trade mark as Cellophane is perhaps one of the best known, and the invention relates more particularly to this substance. Commercially, cellophane can be obtained in the form of thin but strong transparent sheets, and is generally produced with a content of glycerine in order to make it flexible. Traces of glycerine in cellophane invariably increase the power factor and lead to large losses when condensers containing cellophane are connected in an electrical circuit. According to the invention, cellophane consisting of a cellulose derivative made without introduction of glycerine is used, and cellophane free from any trace of glycerine is thus obtained. The cellulose may include for flexibility some other substance, which may be wax or rubber, or anything which will disappear entirely in the process, or produce qualities in the cellophane not electrically undesirable. In practice, cellophane, which has the form of thin, transparent sheets of the required length, width and thickness and of the necessary strength is laid between sheets of metal or metal foil, part of which are to be connected to one terminal of an electric circuit and the remainder to the opposite terminal. When made in accordance with the invention, cellophane free from glycerine and other materials which may impart qualities that are electrically undesirable, becomes a very efficient and satisfactory insulation of low power factor and greatly reduce losses.—*September 8th*, 1927.

276,935. May 28th, 1927.—Gasometers, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

This invention is concerned with that type of gasometer or gas holder in which the usual bell and water basin are replaced by a fixed holder with a piston-like diaphragm, kept gas-tight by means of a liquid seal. The especial object is to prevent the escape downwards of the liquid, such as the tar produced in the



manufacture of water gas, used in the seal. Round the periphery of the piston there is an annular channel, a cross section of which is shown in the drawing, for the reception of the sealing liquid. The joint between the piston and the shell of the holder is made by a series of sliding shoes A, which are pressed against the shell by counterweights, as shown. A strip of canvas B completes the closure.—*September 8th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Cost and Works Accountants.—Connaught Rooms, Great Queen-street, Kingsway, London, W.C. 2. Annual Conference. Papers, "How Cost Accounting Reduces Costs," by Messrs. C. N. Matthews and J. R. Blyth; and "The Problem of the Half-filled Shop," by Messrs. A. Winder and W. B. Walker. 10.30 a.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Presidential address, by Sir Henry Fowler, K.B.E. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecture, "Piling in General with Special Reference to the Vibro Concrete Piling System," by Mr. M. McCarthy. 7.30 p.m.

West of Scotland Iron and Steel Institute.—Room 24, Royal Technical College, George-street, Glasgow. Presidential address by Mr. John Craig. 7 p.m.

SATURDAY, OCTOBER 22nd.

Institution of Municipal and County Engineers.—North-Eastern District meeting at Billingham, Durham. 2.30 p.m.

Institution of Municipal and County Engineers.—The Mansion House, Doncaster. Yorkshire District meeting. 11 a.m.

MONDAY, OCTOBER 24th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Presidential address, "The Influence of the Automobile User upon the Automobile Engineer," by Major E. G. Beaumont. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Graduates' Section meeting. "The Liquefaction of Air," by Mr. J. Rogers. 6.30 p.m.

WEDNESDAY, OCTOBER 26th.

Institution of Automobile Engineers: North of England Centre.—The Engineers' Club, Albert-square, Manchester. Presidential address, "The Influence of the Automobile User upon the Automobile Engineer," by Major E. G. Beaumont. 7 p.m.

Institution of Civil Engineers: Yorkshire Association.—Grand Hotel, Leopold-street, Sheffield. Address by the Chairman, Professor J. Husband. 7.30 p.m.

THURSDAY, OCTOBER 27th.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Ltd., Luton, Beds. Luton Graduates' meeting. 7.30 p.m.

Institution of Mining and Metallurgy.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers: "The Nickel-cobalt Ore of Talnotry, Kirkcudbrightshire," by Messrs. J. W. Gregory and D. Leitch; and "Operative Causes in Ore Deposition," by Mr. H. C. Boydell. 5.30 p.m.

FRIDAY, OCTOBER 28th.

Faraday House Old Students' Association.—Savoy Hotel, Strand, London, W.C. 2. Nineteenth annual dinner.

Institution of Chemical Engineers.—Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. Lecture, "Crystallisation," by Sir William Bragg, F.R.S. 6.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Paper, "Locomotive Performance and its Influence on Modern Practice," by Mr. E. C. Poultney. 7 p.m.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Engineering in the United States of America," introduced by Mr. L. St. L. Pendred. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street London, S.W. 1. Informal meeting. Display of technical film illustrating the production of cotton goods. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Newcastle-upon-Tyne. Annual general meeting. Presidential address by Mr. Maurice S. Gibb. 6 p.m.

SATURDAY, OCTOBER 29th.

Institution of Automobile Engineers.—London Graduates' visit to the works of Clement-Talbot, Ltd., Barlby-road, Ladbroke-grove, London, W. 10. 2.30 p.m.

WEDNESDAY, NOVEMBER 2nd.

Institution of Electrical Engineers.—Savoy place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Opening address by the Chairman, Lieut.-Colonel A. G. Lee. 6 p.m.

FRIDAY, NOVEMBER 4th.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Thomas Hawksley lecture, "Application of X-rays to the Study of the Crystalline Structure of Materials," by Sir William H. Bragg. 6 p.m.

CONTRACTS.

The Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross, London, N. 1, has received an order for signalling equipment for a further thirty-seven stations on the F.C. Santander-Mediterraneo. This order follows the supply last year of equipment for thirteen stations, which are already in service. The company's double-wire system of mechanical signalling has been adopted, including mechanically-operated three-aspect signals. The same firm has received orders for Westinghouse compressed air brakes, as follows:—From Guy Motors, Ltd., eight sets, for electric trolley omnibuses for the Hastings tramways; and from Ransome, Sims and Jefferies, Ltd., nine sets, for trolley omnibuses for the Maidstone Corporation.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

H.R.H. The Duke of York has graciously accepted an invitation to the annual dinner of the Institution of Mechanical Engineers in London on December 15th.

Snow and Co., Ltd., of Stanley-street, Sheffield, ask us to announce that they have made arrangements with Messrs. Reynolds and Wilson, of Abbey House, Victoria-street, S.W. 1, to represent them in London and the South of England.

The British Commercial Gas Association asks us to announce that it has changed its editorial address from 28, Grosvenor-gardens, S.W. 1, to 32, Victoria-street, London, S.W. 1.

The Stream-Line Filter Company, Ltd., asks us to announce that it has changed the address of its office from 64, Victoria-street, to 45, Horseferry-road, Westminster, London, S.W. 1. The telephone numbers remain the same, namely, Franklin 6150/6151, and the telegraphic address is Edgefilt, Sowest, London.

The Motor Train Ferry Korsor.—In The Engineer of June 3rd there was described and illustrated the oil engine propelled train ferry Korsor, which is claimed to be the largest vessel of its kind in the world. We have recently received from Burmeister and Wain, Ltd., of Copenhagen, a well-illustrated booklet in which the propelling machinery of the Korsor and its arrangement are described. Plans and views of the ship's accommodation are given, together with the ship's trial performance on the Great Belt Railway service.

Royal Institution: Juvenile Christmas Lectures.—The titles of series of lectures on "Engines," which is to be delivered by Dr. Edward N. da C. Andrade, D.Sc. Ph.D., Professor of Physics, Military College of Science, Woolwich, and which forms the one hundredth and second course adapted to a juvenile auditory, are announced as follows:—(I.) "The Rules which all Engines Must Obey," Thursday, December 29th; (II.) "Learning about Steam," Saturday, December 31st; (III.) "Engines which Work To and Fro," Tuesday, January 3rd, 1928; (IV.) "Engines which Work Round and Round," Thursday, January 5th; (V.) "Putting the Furnace in the Cylinder," Saturday, January 7th; and (VI.) "Heat Engines which Produce Cold," Tuesday, January 10th. In each case the lectures will begin at 3 p.m.

Lightning Conductors.—There are some interesting anecdotes in a lecture which Mr. G. A. Collier, of W. J. Furse and Co., Ltd., gave recently before the Nottingham Society of Engineers, some of which come within our own experience, and they all go to show two things—that a good lightning conductor is something of an insurance, while, on the other hand, the best of conductors may, unluckily, prove ineffective. It is, of course, well recognised that conductors should have an easy lead, with no sharp angles, while any joints must be "metal-to-metal" and be maintained in good order; but even then it would seem that there is a certain degree of luck in the efficacy of such precautions. We have in mind, for instance, the case of a 200ft. steel chimney in the Far East. It was built on a brick base some 20ft. high and there was no metallic connection from the chimney to ground. Nevertheless, although we have seen it struck by lightning several times, the base was never damaged in the least. Mr. Collier's stories are fascinating and his explanations of steeplejack work interesting. Messrs. Furse tell us that they will send copies of the lecture to anyone really interested in the subject.